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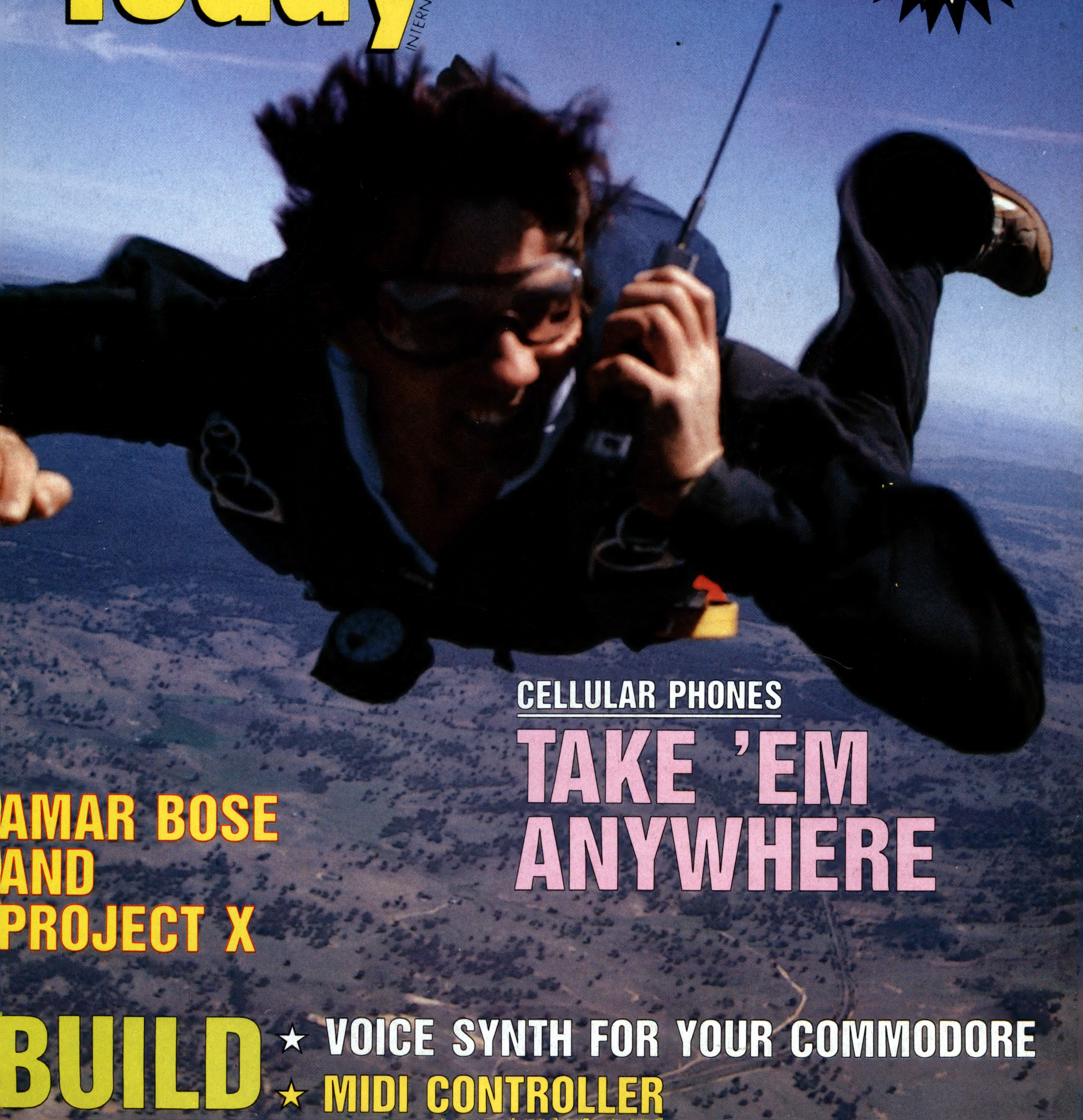

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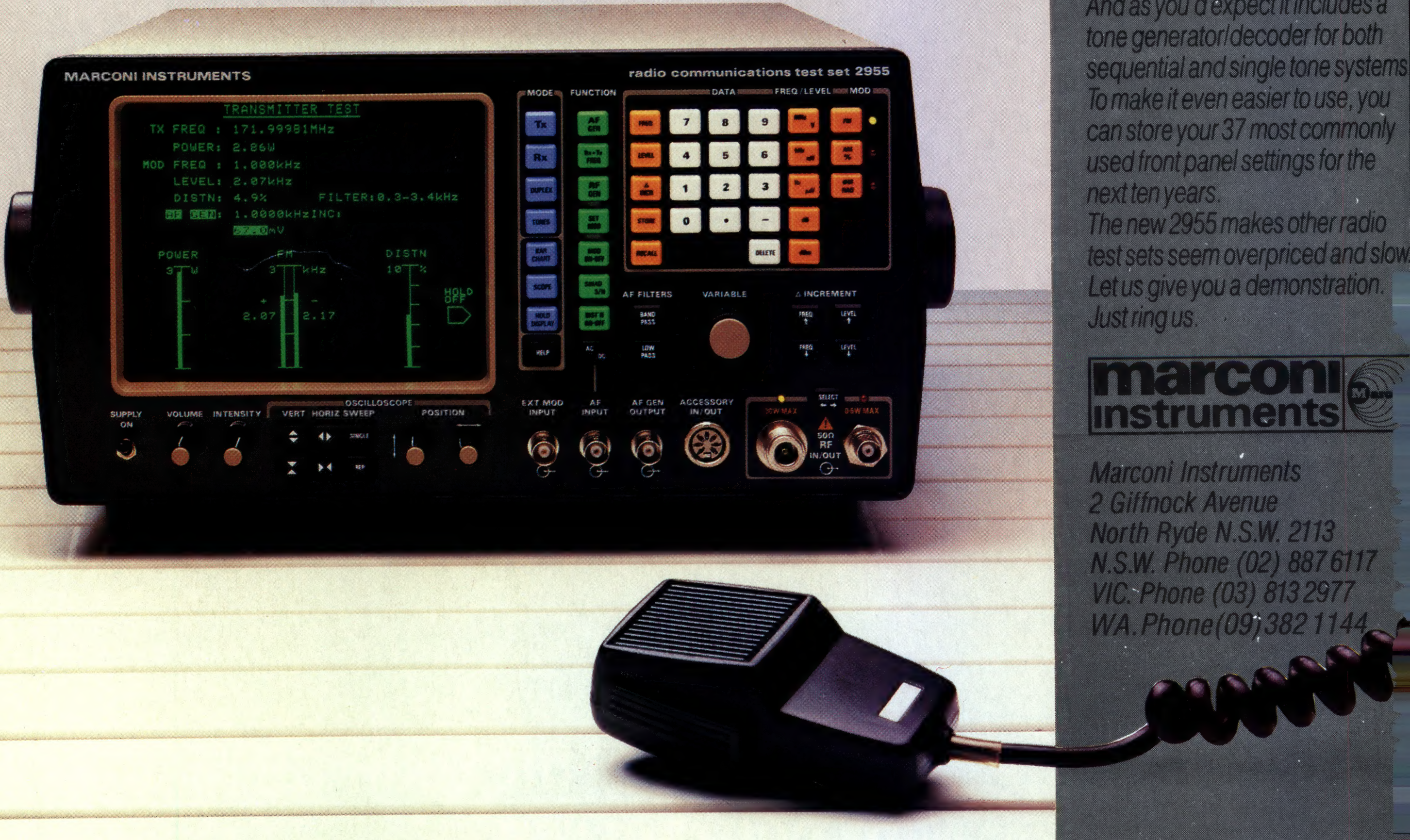

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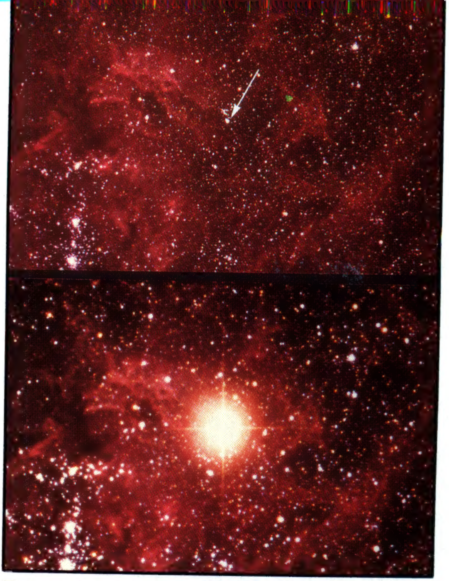
COVER: Mark Hay's study of Phillip Onis, from the Sydney Skydiving Group, demonstrating the versatility of the MOBILETRONICS CELLULAR PHONE from PIRANHA CAR ALARMS. "Be home in five minutes ma".



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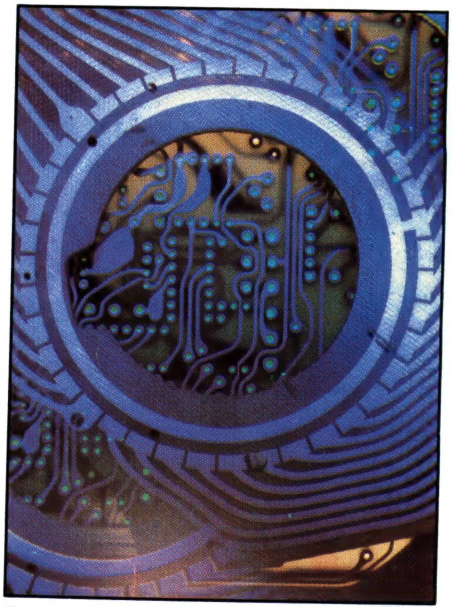

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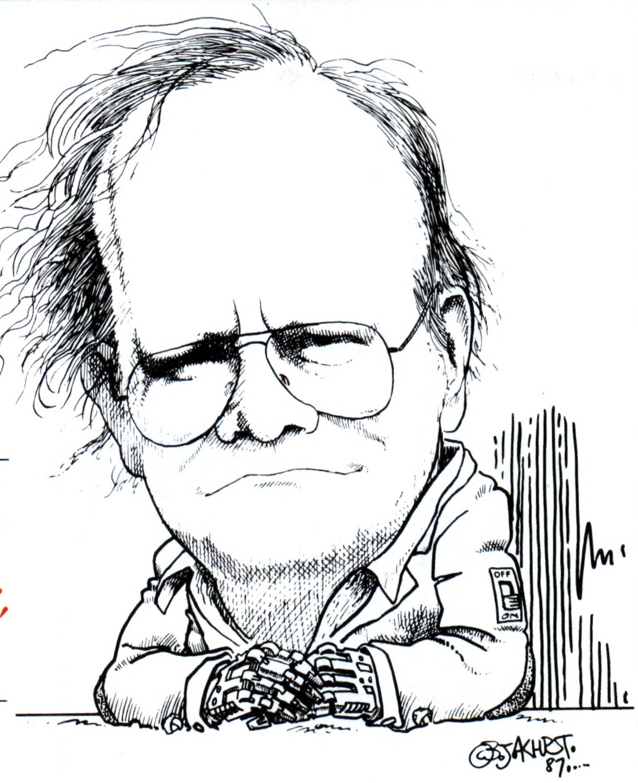

> *Of course to have done anything else would have been 'novel, 'innovative', or even worse 'courageous'.*

The Minister of Defence, Mr Kim Beasley, recently released the long awaited Defence White paper. The paper is the government's response to the Dibb report, an independent report in which Australia's defence options were outlined.

Both reports are full of a most remarkable amount of hot air. This is not surprising. Australia faces no conceivable threat from any quarter during the rest of this century, so any defence planning will take place in an almost total vacuum. The only possible reason for Australian troops to be firing off 'the odd angry shot' this side of 2000 will be if the Americans drag us into another morass as they did in Vietnam. And Dibb, but more so Beasley, leave us in little doubt that we are still right in there, hanging on Uncle Sam's coat tales.

So why is it interesting at all? Well, the Defence department soaks up more money than any other government body except Social Welfare, and while Social Welfare is being cut, Defence is being expanded. To do nothing about anything, we will spend something like $15 billion.

Who will this please? Not the taxpayer for sure. It may well amuse any Russians who happen to read it buried at the bottom of page 53 in Pravda. In the US of course, they will be ecstatic. On past performance much of that $15b will wind up in the hands of Californian defence contractors. Money for the bosses, jobs for the workers.

What a pity neither Dibb nor Beasley could find it in themselves to use this priceless opportunity to help Australian industry. What kind of a difference would it make to Australian computer companies if the government was handing out a few million dollar contracts for Defence electronics; if our space industry was to develop a few new rockets or a communications satellite for the services, $15 billion can make a lot happen. As it is, Australian Industry will have to make do with a contract for six submarines, designed overseas and built in our dockyards. A reward for inefficient managements and bloody minded workers.

Of course, to have done anything else would have been 'novel', 'innovative' or even worse, 'courageous'. Anyone who follows 'Yes Minister' will understand just how reprehensible that would have been.

Reader Services

As of this month, readers will notice that many of the articles, as well as the advertisements in the magazine carry reader service numbers. We have been running these on the advertisments only for the last two months, and the results have been exciting, both for advertisers and ourselves. It's obviously a service you want, so we've decided to use it on articles and news items as well. Reply to us on the card in the middle of the magazine.

John Fairall
Editor

EDITOR
Jon Fairall B.A.

ASSISTANT EDITOR
Simon O'Brien B.A. (Hons), M.A.

EDITORIAL STAFF
S. K. Hui B.Sc. (Hons), M.Eng.Sc. MIEEE, MIREE
Terry Kee B.Sc. (Hons), M. Phil.

DRAUGHTING
Bruce Mennie

DESIGNER
Clive Davis

ART STAFF
Ray Eirth

PRODUCTION
Mark Moes

ADVERTISING MANAGER
Peter Hayes B.Sc.

ADVERTISING PRODUCTION
Brett Baker

SECRETARY
Naomi Lenthen

ACOUSTICAL CONSULTANTS
Louis Challis and Associates

PUBLISHER
Michael Hannan

MANAGING EDITOR
Brad Boxall

HEAD OFFICE
180 Bourke Road, (PO Box 227, Waterloo, NSW 2017)
Alexandria, NSW 2015.
Phone: (02) 693-6666.
Telex: AA74488, FEDPUB.
Federal Facsimile: (02) 693-2842.

ADVERTISING
New South Wales & Queensland: Peter Hayes, Mark Lewis, The Federal Publishing Company, 180 Bourke Road, Alexandria, NSW 2015. Phone (02) 693-6666. Telex: AA74488 FEDPUB.
Victoria and Tasmania: Virginia Salmon, The Federal Publishing Company, 23rd Floor, 150 Lonsdale Street, Melbourne, 221a Bay Street, Port Melbourne, Vic. 3207. Phone (03) 646-3111. Facsimile: (03) 646-5494. Telex: AA34340, FEDPUB.
South Australia and Northern Territory: Michael Mullins, C/- John Fairfax & Sons, 101-105 Waymouth Street, Adelaide, 5000. Phone (08) 212-1212. Telex: AA82930.
Western Australia: Estelle de San Miguel, C/- John Fairfax & Sons, 454 Murray Street, Perth, WA 6000. Phone: (09) 481-3171. Telex: AA92635.
New Zealand: John Easton, 3rd Floor, Communications House, 12 Heather Street, Parnell, Auckland. PO Box 8770, Symonds St, 37-291. Telex NZ63122. Phone 79-6648 (Auckland).
Britain: Peter Holloway, C/- John Fairfax and Sons, 12 Norwich Street, London EC4A IBH. Phone 353-9321.
USA: Frank Crook, Sydney Morning Herald, 21st Floor, 1500 Broadway, New York, NY 10036. Phone 398-9494.
Japan: Bancho Media Services, Dai Ichi Nisawa Building, 3-1 Kanda Tacho 2-Chrome, Chiyoda-Ku Tokyo 101. Phone Tokyo (03) 252-2721.

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Traffic package export to Singapore

Using an unusually entrepreneurial combination of private and government technologies, Australia has secured a significant contract for a SCATS area road traffic control system to cover the whole of the central business district of Singapore.

Worth $S3m, the turnkey project for the Singapore Public Works Department represents a major milestone for Australian traffic control expertise and industry.

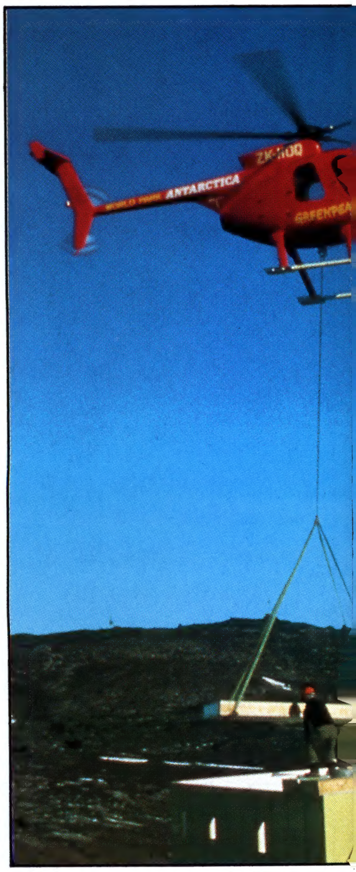
The contract was won by Philips in collaboration with the Road Traffic Authority of Victoria (RTA).

Replacing existing fixed time automatic traffic controllers and covering 180 traffic intersections, the new dynamic on-line system will have the flexibility to respond effectively to sudden changes in traffic conditions and will also enable the collection of data on traffic flow patterns at all hours of the day and night. This data will assist Singapore officials in daily operations and in forward planning.

The RTA will be responsible for adapting and commissioning the SCATS system (Sydney Coordinated Adaptive Traffic System) which was originally developed by the NSW Department of Main Roads and is now claimed to be the world's leading traffic responsive area control system. In addition to installations throughout Australia and New Zealand, SCATS systems are in use in China.

Incorporated in the Singapore project will be a powerful colour graphics display, visually depicting the various system levels of a 'bird's eye' view of the total traffic of the Singapore island, right down to individual intersections and even each lane at an intersection. The whole system is controlled by 180 PTF microprocessor controllers.

Traffic movements are captured by vehicle loop detectors which monitor the loops in the road surface in each lane at an intersection. More than 300 of these Australian-designed and manufactured 4- or 8-channel detection units will be used in the Singapore system.



Greenpeace in Antartica

The famous naturalist organisation Greenpeace is looking for a group of intrepid souls to spend the winter of 1988 at its newly established base in the antarctic. One of the foremost characters they are looking for is a radio technician.

The Greenpeace base is the first non-national scientific station to be established in the frozen continent. The organisation hopes to use this fact to further its aim of having the area declared a 'World Park'.

The 'overwintering' team which will occupy the base in 1987 is composed of people from New Zealand, from where the expedition will set forth, and Europe. The leader of the troupe is a New Zealander Kevin Conaglen who has experienced antarctic conditions before when he worked at New Zealand's

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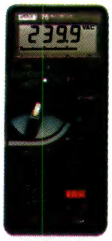

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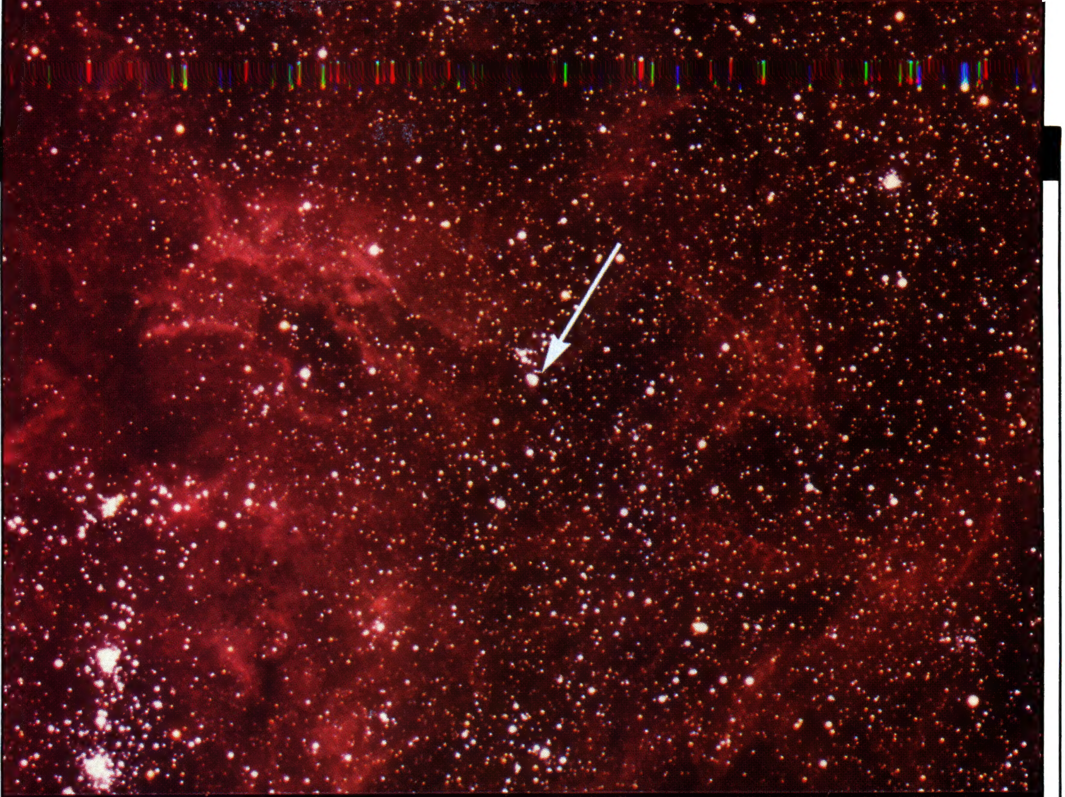
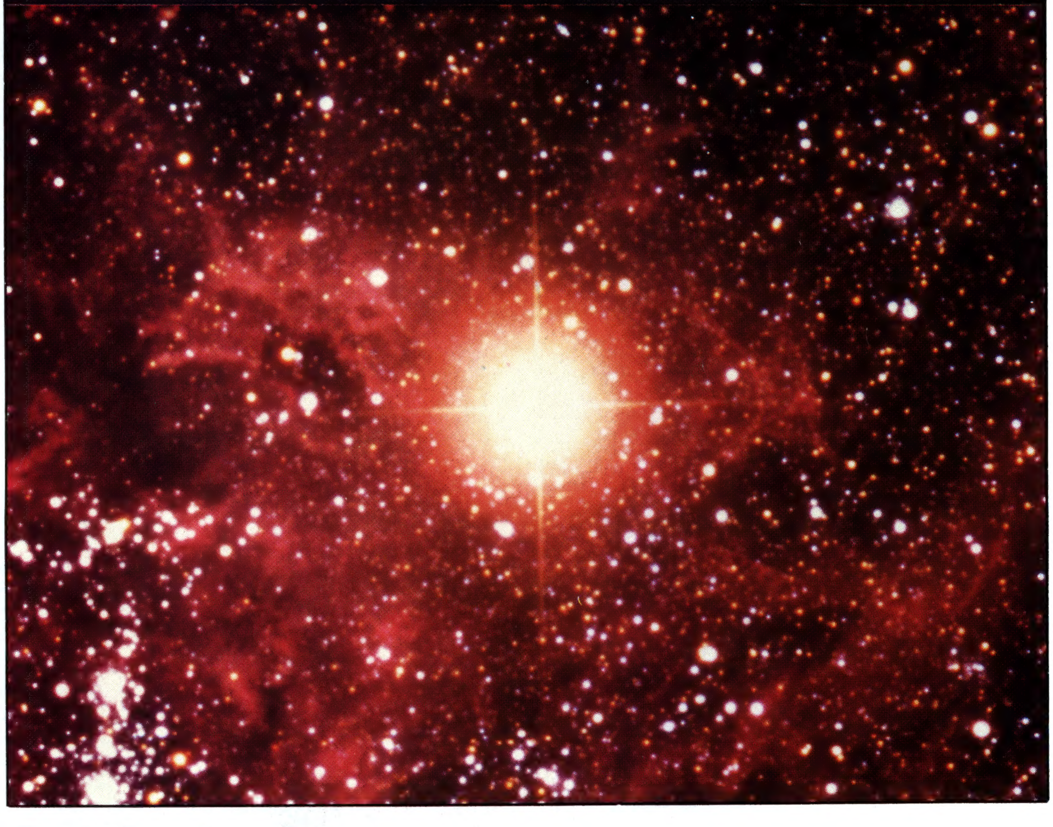
The construction of the Greenpeace base

Scott base.

The Greenpeace base is located at Home Beach on Cape Evans, Ross Island, in the South-Western Ross Sea area. It consists of a prefabricated building 16.6 metres long and 6.25 metres wide. Within this small area are included individual sleeping quarters, a kitchen, dining and living area, laboratory, service room and a separate generator shed. Power for the station will be provided to two diesel generators. True to their environmental convictions the Greenpeace crew will gather all the wastes produced during the stay and take them back home.

The establishment of this base will grant Greenpeace observer status at various Antarctic Treaty meetings. It is these meetings which will determine the future status of the antarctic region.





Death of a Star

The first close Supernova since the advent of the telescope sent astronomers scrambling for their instruments recently. A Supernova is a gigantic stellar explosion, in which the core of a dying star implodes, forming a neutron star or black hole, and the exterior explodes, sending perhaps 80% of its matter back into outer space. Astronomers are excited because Supernovae are the only known way in which elements other than hydrogen and helium can be returned to the interstellar medium after they are created in a star. They are also important in measuring interstellar distances.

The top photograph shows a portion of the Magalenic cloud taken two years ago by the AAT. The bottom picture of the same star field was taken by David Malin and Ray Sharples a fortnight after the explosion.

NEWS DIGEST

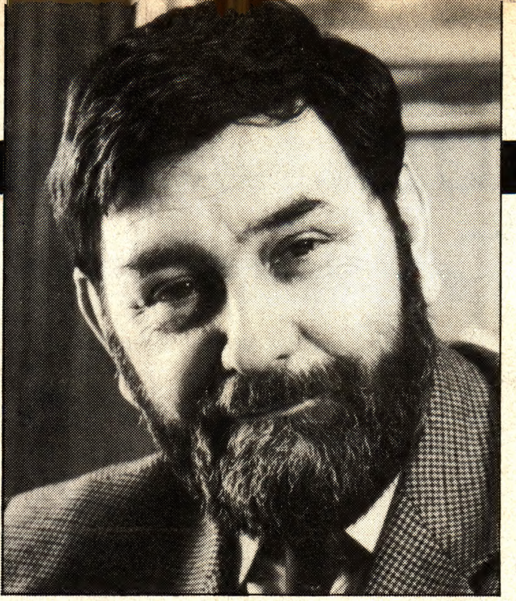
The South East Convention

The South East Radio Group will hold its 23rd annual convention at Mt Gambier beginning on 6 June. The convention traditionally attracts many companies involved in selling amateur radio equipment. Social activities play a great role in the convention and hopefully a good time will be had by all.

Optical Systems Design

March this year witnessed the birth of a new Australian company, Optical Systems Design Pty Ltd. According to its Managing Director, John Wise, the new company will run as a consultancy and will offer 'a comprehensive service in fibre based systems'.

Mr Wise believes that although fibre optics 'is now a mature technology applicable to many communications requirements' the new technology is rarely applied "in a sensible, cost effective manner". Interestingly enough "fibre is sometimes used where more conventional technologies are a better solution".


Barry Jones

A New Instrument

On 11 February this year the Federal Minister for Science, Mr Barry Jones, awarded a $250,000 cheque to Sydney University for the construction of the world's most powerful 'Interferometer' which will be installed at Culgoora, 20 km west of Narrabri. Construction of the new device will begin in mid year and, all things being well, should be in operation some time around 1990.

An Interferometer is a device for gathering basic information about the stars such as their size, temperature and distance. Australia leads the world in this type of research due mostly to the brilliance of Professor Hanbury Brown who constructed the first optical interferometer in 1961. In fact the scales used to measure the temperatures of the stars were derived from the information obtained from this instrument.

Those concerned about the health of Australia's technological industries will be comforted by the knowledge that 85 per cent of the instrument will be built by Australian companies in Australia. It will also be a considerable improvement on its predecessor for where the original interferometer was only able to study 35 stars the new machine will examine 25,000. It is hoped that such a wealth of information will occupy Australia's astronomers for many years to come.

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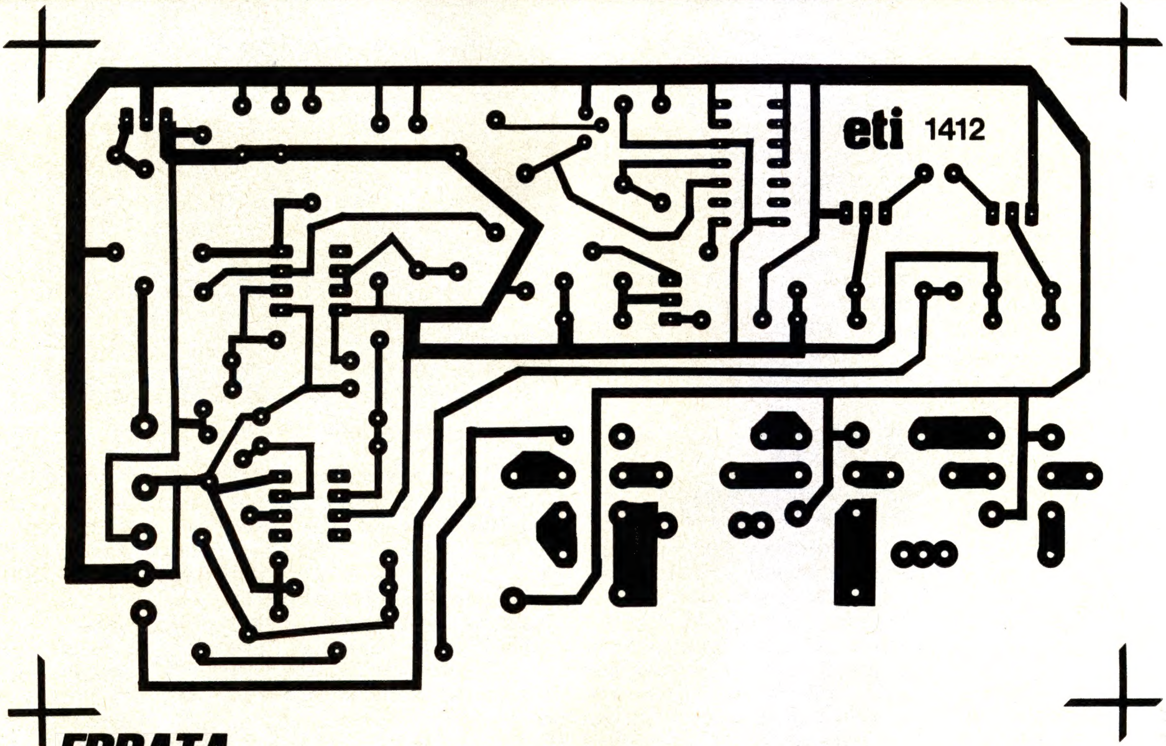
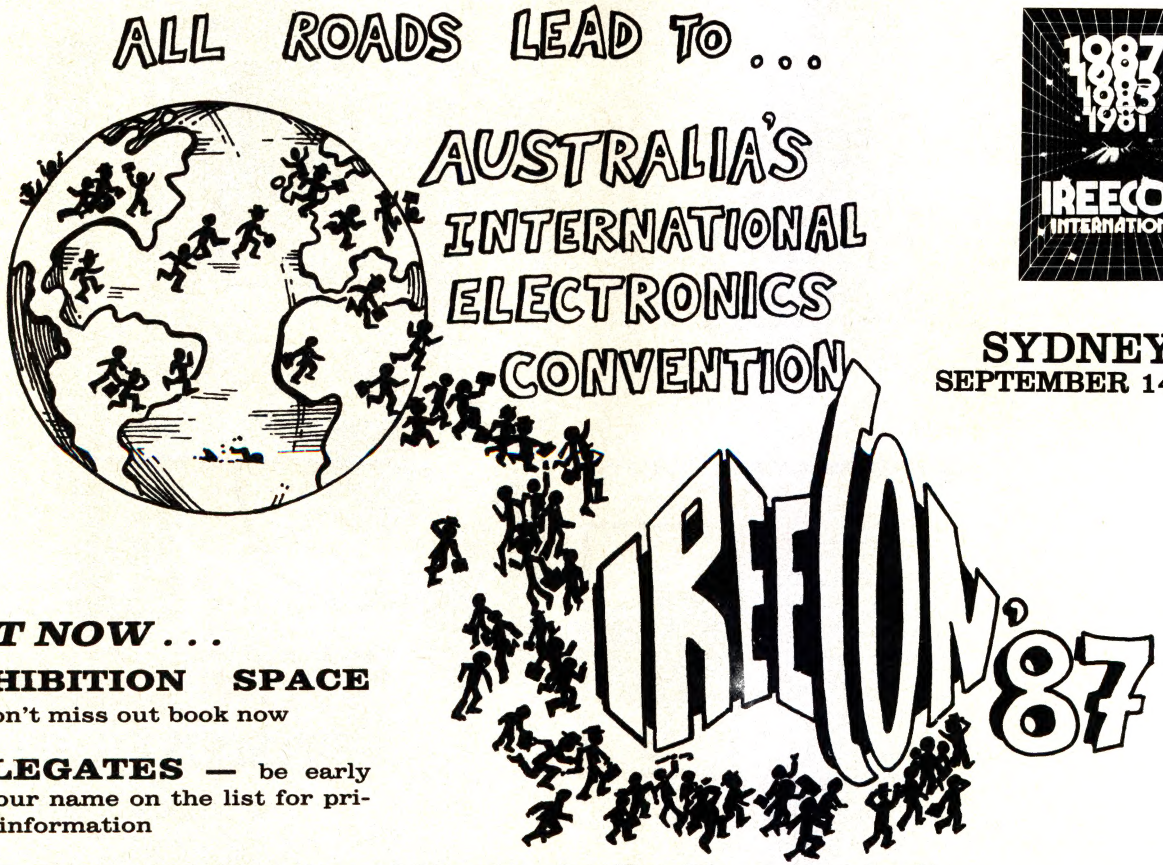


ERRATA

The circuit layout for the STEREO LOUDSPEAKER SWITCHER printed on page 61 of the February ETI was of course incorrect. The correct version is printed above. We apologise to all our readers.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NASA prepares for Planetary missions

NASA has selected the Inertial Upper Stage (IUS), a launch vehicle which fits in the cargo bay of the space shuttle to carry probes to Jupiter, Venus and the sun. However, an option is being kept open until early next year to use a Titan IV on one of these missions.

NASA selected the upper stage, for three planetary missions, Galileo, Magellan and Ulysses, to be launched in 1989 and 1990. These missions will be the first to employ an IUS to carry payloads to study other bodies in the solar system.

Each of the planetary payloads will use a standard two-stage IUS. Ulysses, which is intended to study the poles of the sun, will require the addition of a Payload Assist Module. The added module, a smaller 'kick' stage, will be needed for additional energy to reach proper orbit around the sun.

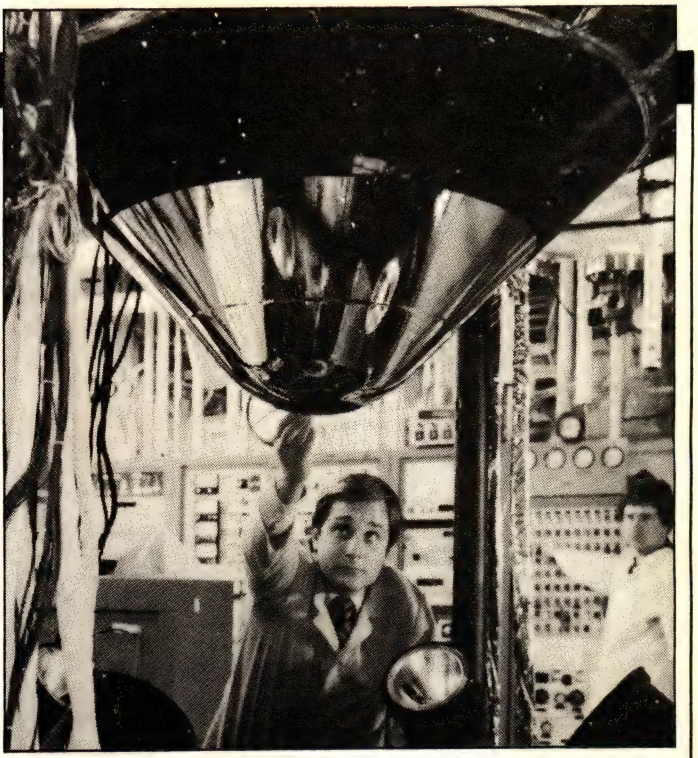
Ulysses is a joint mission of NASA and the European Space Agency (ESA). ESA funded and built the Ulysses spacecraft, NASA will launch it, and both groups will receive data back.

The IUS is a two-stage, 17-foot-long vehicle weighing more than 16 tons. It has already been employed to carry payloads to geostationary orbit, although it was always intended for both Earth-orbital nd planetar5y missions.

The Magellan mission will orbit Venus and map its surface with radar, since the cloud cover of the planet obscures direct vision.

Galileo will orbit Jupiter for nearly two years to measure such things as electromagnetic fields and plasma particles. The orbiting spacecraft also will send down an atmospheric probe for on-site readings, although the probe is expected to last for no more than a few hours because of the intense atmospheric pressure. Galileo is a joint mission of NASA and Germany, which developed the retropropulsion system for the probe's descent into the Jovian atmosphere.

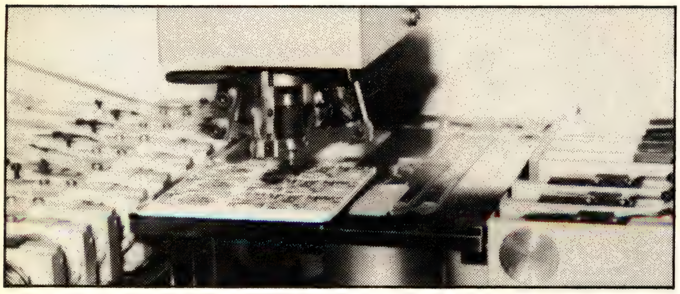
The study of the solar poles by Ulysses will be the first time in the history of the space program that the area has been investigated.


Business end of the Galileo orbiter.

NASA has also signed a contract for the upper stage that will propel the Mars orbiter on its way to the red planet in the early 1990s. The Mars orbiter is designed to make an 18 month trip to Mars, then orbit the planet for two years with a variety of remote sensing instruments on board. This will result in a high resolution survey of the planet, preparatory to manned flights, which will probably take place around 2000.

The new upper stage is called the Transfer Orbital Vehicle or TOS. It's designed to fit into the cargo bay of the shuttle, but it could also be launched on board an expendable Titan launch vehicle. NASA would like to use the shuttle, but if space is not available it might be forced to use the aging but still serviceable Titans to keep its space program going.

Exporting Telephones


Placing surface mount devices. courtesy Philips

Philips have developed a new cellular radio phone for use in Telecom's Mobilenet system. This device will be conmpatible with the systems used in the US and Canada.

Philips have invested large sums into the development of the new device which is being manufactured at the Clayton plant in Victoria. It is being built using advanced surface-mount and large scale integration components.

The fact that the new phone suits the standard of other national cellular systems should provide great opportunities for export. In 1986 sales of such machines in the US were estimated at more than US$500 million. Even if the Philips' phone does not sell overseas it should do well for Telecom estimates that it will have 200,000 cellular subscribers across Australia within 10 years.

New life for offsets policy

The government's troubled offsets policy, which has been maimed by lack of compliance on the part of foreign companies, has received a new lease of life as a result of new government initiatives.

Normally, under the offsets policy, companies that sell products or services to government authorities are obliged to develop or buy products in Australia. Under the new arrangements the government will allow companies to satisfy offset obligations through a third party.

The first such deal was concluded recently in New York with the Ocean Capital Corp of New York. OCP is a venture capitalist, and under the new deal, companies with offset obligations will be allowed to invest in OCP, which will in turn invest in venture capital enterprises in Australia.

Ocean Ventures will consist of separate investment pools in Australia, the US and Britain. The Australian part will be managed by McIntosh, Hamson, Hoare and Govett Ltd.

DO IT YOURSELF TV

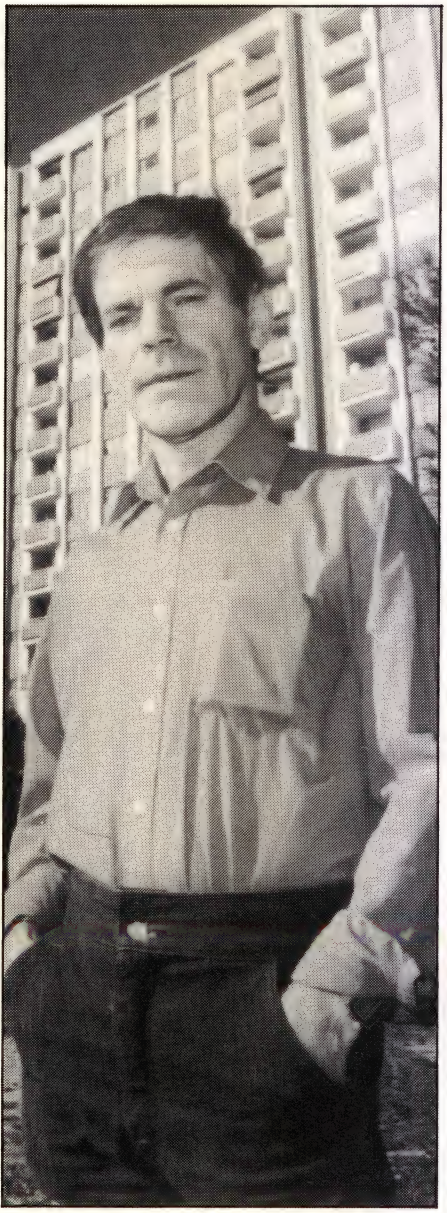
Cable TV has arrived, creeping in the back door while the media barons look the other way.

Simon O'Brien

Ask most Australians what they regard as the most dramatic happenings to occur in the national media in recent months and they will probably mention the big money monopoly games of the various media barons. In fact, however, the most exciting development in Australian television is not taking place in some plush executive boardroom or on the floor of various stock exchanges but on a housing estate in the Waterloo area of Sydney. In a few weeks the people of this area will have the opportunity to subscribe to Australia's first community owned cable TV system.

As we all know there is nothing particularly new about cable TV or even community ownership, such things have existed in the US and elsewhere for years. However, Australia has lagged behind in both areas. This has largely been due to the findings of a Senate inquiry into cable television. The good Senators found that such networks would be 'uneconomic' which usually means the death of any creative scheme.

Enter Mr Royce Sutcliff. Sutcliff had recently returned from a prolonged stay in England and he had been granted a flat on the Waterloo estate. Whilst walking across the road to inspect his intended premises he chanced to cast his eyes skyward and observed a common TV aerial on top of one of the famous 'Redfern Towers'. This, apparently, immediately suggested to him the idea of a cable TV station which would serve all the inhabitants. Of course these self same aerials had been spotted by many in the past but Sutcliff had an advantage in that he had had experience in the electronic media whilst working as a social worker with children for the Camden Borough Council in London. During this time Mr Sutcliff had attempted along with others, to set a cable TV station in the Camden area but had been discouraged by the the local council which wished to use the project to advertise itself. The British Government of the time was also unhelpful, informing him that such a scheme would contravene the Broadcasting Act and was expressly forbidden.


The indomitable Mr. Sutcliff

As discouraging as this might have been Sutcliff resolved to try again. What he envisioned for the Waterloo project was employing the cable used in the mutual antenna system to transmit the new channel to the various subscribers. At first glance the obstacles seemed enormous. For one thing there was bureaucratic regulations. We are often told in Australia that we are too bound up with government rules and departments. Royce Sutcliff found otherwise. He first wrote to the Department of Communications to inquire about the Australian Broadcasting Act. The Department wrote back to say that Act did not cover such a scheme and 'wished him well'.

Apparently, as the situation stands at this moment there is no government regulation preventing you from setting up a cable TV station in your area providing that a. you do not cross a road with your cables and b. you do not take programmes directly off-air. Obey these and the obvious censorship restrictions and you are free to go. At least legally, there still remain the irritating little problems of money, equipment and expertise.

In order to determine the extent of the financial commitment the station would require Sutcliff and his fellow enthuasiasts asked Davron electronics to give a quote for connecting up the three main buildings of the Redfern towers to the cable network. Since most of the buildings had already been connected up the total bill was quite cheap, at $2280. It has been estimated also that the cost of connecting up each subscriber is only $7. Of course, the cost of the necessary equipment in the studio is considerably more.

Where is the money to come from? At the moment it is coming in from a variety of sources. The Department of Housing is expected to give a certain amount as are Telecom and the Sydney City Council. In the latter instance, interest centres around how the new station could keep constituents better informed about the activities of their representatives on the council. Sutcliff even has hopes of filming the council in session, which in the light of recent events would make gripping viewing.

There remains the question of studio equipment. As is presently envisaged the

The famous Redfern towers

main items required besides a Sony 6 video camera are a modulator and computer which will maintain the notice board and keep the community cable station running for twenty-four hours a day. Much of this material will be supplied by SAM Technology a Dutch firm which specialises in installing cable TV in Europe. For the near future SAM are prepared to loan both of these units to the project. SAM (or Telecom) will also provide the coaxial cable and the amplifiers needed to transmit the signal. Much of the video equipment needed for the project has been loaned by the Department of Housing. Metro TV, another intended community TV station, allows the staff of CTV-1 free editing time.

Finally there are the important questions of expertise and management. As regards overseeing the setting up of the station and guiding it through its earliest stages Sutcliff himself is supplying many of the skills. He emphasises, however, that he will "fight to the death" to ensure that the new station is run ultimately by the subscribers themselves. As things are planned at the moment the programming board will consist of elected representatives of the subscribers. Expertise in particular areas will be sought from the outside. As was the case with the equipment, people are being remarkably cooperative over this. The Redfern Legal Centre, for example, is looking after the legal issues involved in setting up the administration of CTV-1. To a large extent this question of management is about the last issue needing to be resolved before CTV-1 hits the airways. Sutclff claims that the station is ready to transmit as soon as the staff receive "the key to the door".

Finally what type of programming will CTV-1 produce? At present this is hard to say, but one can be sure that its programmes will be unique. Sutcliff envisions consumer interest shows which will inform the residents of the area of their legal rights as regards such fundamental matters as tenancy. The noticeboard, which will be on of the first features transmited by CTV-1 will keep all subscribers aware of social events happening in their area. For much of the initial period Sutcliff envisions making use of recorded material such as that supplied by the United Nations Organisation and other such bodies. As time goes on, however, he would like to see the station make extensive use of local talent. "The people of this area, like any other Australian suburb, often feel either ignored or intimidated by the media. What we hope to do is offer them a hands on approach to television which will increase, rather than decrease their confidence in their abilities to create and communicate with each other". Laudable aims which reflect a stimulating new approach in Australian television. ●

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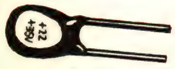
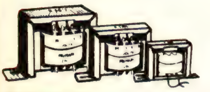


TAG TANTALUM CAPACITORS SPECIALS!

Cat.No.	Description	Price
R16124	16V 4.7uF	$0.48
R16125	16V 10uF	$0.52
R16126	16V 15uF	$0.75
R16128	16V 22uF	$0.85
R16216	25V 2.2uF ..	$0.40
R16220	25V 4.7uF ..	$0.70
R16222	25V 6.8uF ..	$0.70
R16224	25V 10uF	$0.60
R16228	25V 22uF	$2.40
R16300	35V 0.1uF ..	$0.30
R16302	35V 0.15uF..	$0.30
R16304	35V 0.22uF..	$0.30
R16306	35V 0.33uF..	$0.30
R16308	35V 0.47uF..	$0.30
R16310	35V 0.68uF..	$0.35
R16311	35V 0.82uF..	$0.35
R16312	35V 1.0uF ..	$0.30
R16314	35V 1.5uF ..	$0.50
R16316	35V 2.2uF ..	$0.50
R16318	35V 3.3uF ..	$0.35
R16320	35V 4.7uF ..	$0.70
R16322	35V 6.8uF ..	$0.80
R16324	35V 10uF	$0.80
R16326	35V 15uF	$1.40
R16328	35V 22uF	$3.50



ECONOMY TRANSFORMERS

	1-9	10+
2155 240V 6-15V 1A Cat. M12155	$9.95	$8.95
2156 240V 6-15V 2A Cat. M12156	$14.95	$13.95
2840 240V 9V CT Cat. M12840	$5.95	$4.95
2851 240V 12-6V CT 150mA Cat. M12851	$5.95	$5.50
2860 240V 15V CT 250mA Cat. M12860	$5.95	$4.95
6672 240V 15-30V 1A tapped Cat. M16672	$14.95	$13.95

QUALITY LEDS

Cat. No.	Description	Price
Z10140	3mm Red	$0.15
Z10141	3mm Green	$0.20
Z10143	3mm Yellow	$0.20
Z10145	3mm Orange	$0.20
Z10150	5mm Red	$0.15
Z10151	5mm Green	$0.20
Z10152	5mm Yellow	$0.20

HIGH INTENSITY RED LED BAR GRAPH

Dimensions:
Overall: 63mm across, 5mm high.
LEDs: 10 x 5mm x 1mm

Cat.No.	1-9	10+
Z10180	$2.95	$2.75

½" HIGH INTENSITY RED LED DISPLAYS

(Available in Common Cathode and Common Anode)

Dimensions:
Overall: 12.7mm across, 19mm high
Display: 12.7mm(H) x 7.3mm(W)
Segment Width: 1.2mm
Brightness: 3400 ucd. I_F =10mA

COMMON CATHODE:
Pin 1 Segment E Pin 6 Segment B
Pin 2 Segment D Pin 7 Segment A
Pin 3 CC Pin 8 CC
Pin 4 Segment C Pin 9 Segment F
Pin 5 Segment Dp Pin 10 Segment G

Cat.No.	1-9	10+	100+
Z10190	$1.95	$1.75	$1.50

COMMON ANODE:
Pin 1 Segment E Pin 6 Segment B
Pin 2 Segment D Pin 7 Segment A
Pin 3 CA Pin 8 CA
Pin 4 Segment C Pin 9 Segment F
Pin 5 Segment Dp Pin 10 Segment G

Cat.No.	1-9	10+	100+
Z10191	$1.95	$1.75	$1.50

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Unencoded keypad, 10 digit keys plus two utility keys. Light grey in colour.

OUTPUT ARRANGEMENT:

Output Pin Nº.	Symbol
1	N.A.
2	Shield plate
3	Column 2
4	Row 4
5	Column 3
6	Row 1
7	Column 1
8	Row 2
9	Row 3
10	N.A.

Cat.C19030

1-9	10+	100+
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1-9	10+	100+
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16 VOLT

Cat.No.	Description	1-9	10+
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R15481	22uF	$0.25	$0.20
R15511	33uF	$0.25	$0.20
R15521	47uF	$0.25	$0.20
R15531	100uF	$0.30	$0.25
R15541	220uF	$0.60	$0.50
R15551	330uF	$0.75	$0.65
R15561	470uF	$0.75	$0.65
R15571	640uF	$0.90	$0.80
R15581	1000uF	$0.90	$0.80
R15601	2200/2500uF	$1.20	$1.10

25 VOLT

Cat.No.	Description	1-9	10+
R15422	2.2uF	$0.25	$0.20
R15432	3.3uF	$0.25	$0.20
R15442	4.7uF	$0.25	$0.20
R15462	10uF	$0.25	$0.20
R15502	25uF	$0.30	$0.25
R15512	33uF	$0.30	$0.25
R15522	47uF	$0.30	$0.25
R15532	100uF	$0.40	$0.35
R15542	220uF	$0.70	$0.65
R15552	330uF	$0.75	$0.65
R15562	470uF	$0.75	$0.65
R15582	1000uF	$1.00	$0.90
R15602	2200/2500uF	$1.40	$1.20

35 VOLT

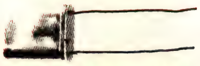
Cat.No.	Description	1-9	10+
R15443	4.7uF	$0.30	$0.25
R15463	10uF	$0.30	$0.25
R15483	22uF	$0.30	$0.25
R15513	33uF	$0.40	$0.35
R15523	47uF	$0.40	$0.35
R15533	100uF	$0.60	$0.55
R15543	220uF	$0.60	$0.55
R15563	470uF	$0.70	$0.60
R15583	1000uF	$1.20	$1.10
R15593	2200/2500uF	$1.50	$1.30

50 VOLT

Cat.No.	Description	1-9	10+
R15404	0.47uF	$0.25	$0.22
R15414	1uF	$0.25	$0.22
R15424	2.2uF	$0.30	$0.25
R15434	3.3uF	$0.30	$0.25
R15444	4.7uF	$0.40	$0.35
R15464	10uF	$0.40	$0.35
R15484	22uF	$0.40	$0.35
R15514	33uF	$0.40	$0.35
R15524	47uF	$0.50	$0.45
R15534	100uF	$0.60	$0.55
R15544	220uF	$0.90	$0.80
R15564	470uF	$1.00	$0.90

63 VOLT

Cat.No.	Description	1-9	10+
R15405	0.47uF	$0.30	$0.25
R15415	1uF	$0.30	$0.25
R15425	2.2uF	$0.30	$0.25
R15435	3.3uF	$0.30	$0.25
R15445	4.7uF	$0.30	$0.25
R15465	10uF	$0.40	$0.35
R15505	25uF	$0.50	$0.45
R15525	47uF	$0.50	$0.45
R15535	100uF	$0.60	$0.55
R15545	220uF	$0.90	$0.80
R15555	330uF	$1.20	$1.10
R15565	470uF	$1.40	$1.20



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Description	Cat.No.	1-9	10+
1MHz	Y11000	$7.50	$7.00
4.433618MHz	Y11023	$2.95	$2.75
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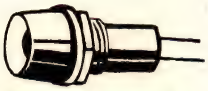
14.31818MHz	Y11072	$2.95	$2.75



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9mm hole, available 3 colours

Cat.No.	Description	Price
S14030	Red	$1.20
S14032	Green	$1.45
S14034	Yellow	$1.45

5 PIN DIN PLUG

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Cat. P10157 .... Normally $1.00

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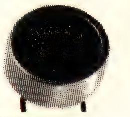

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Sensitivity (dB/v/ubar) min.:
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Bandwidth (kHz):
Transmit: 4.0 (at 100dB)
Receiver: 5.0 (at −73dB)
Impedance:
Transmit: 500
Receiver: 5000

Cat. L19990 (Transmitter) .	$4.75
Cat. L19991 (Receiver)	$4.75

MINI JUMPERS

- Contact terminal: Phospor bronze
- Material: P.B.T. 94V-0
- Gold plated

Qty	Cat. No.	Price
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100	P12057	$21.95

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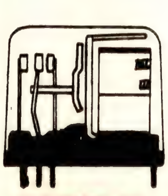
Cat. M10104 .... $1.45



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Minor Scale Division: 1/500 turn
Shaft Bore: 6.35mm (¼")
Finish: Satin Chrome
Body Size: 25.4 x 44.45mm (1 x 1¾")
Depth: 25.4mm (1")
Weight: 45.4g (1.6oz.)
Cat.R14405 .... $45.95

MODEL 16-1-11

Number of turns: 15
Minor Scale Division: 1/50 turn
Shaft Bore: 6.35mm (¼")
Finish: Clear Anodize
Body Size: 22.2mm diameter (.875")
Depth: 22.2mm (.875")
Weight: 19.8g (0.7oz.)
Cat.R14400 .... $26.95

MODEL 21-1-11

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Shaft Bore: 6.35mm (¼")
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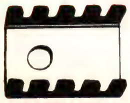

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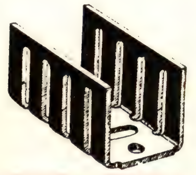

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Universal because of the hole pattern which allows it to be mounted to most "power" type semiconductors. Features vented sides and black anodised finish for maximum efficiency.
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P10960	3 pin line male. Was $3.90	NOW $2.90
P10962	3 pin chasis male Was $3.00	NOW $2.40
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P10966	3 pin chasis female Was $4.95	NOW $3.45

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WO4 1A 400V Cat. Z11032	$0.35	$0.30	$0.28
SB604 6A 400V Cat. Z11034	$0.90	$0.80	$0.75

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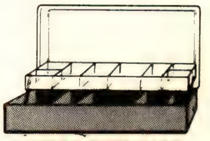

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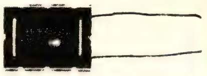

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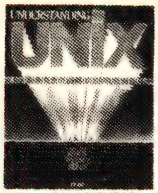

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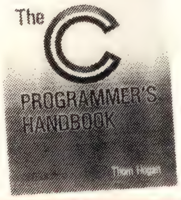

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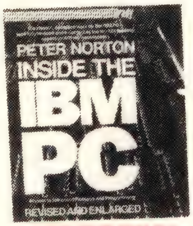

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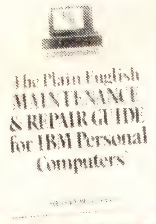

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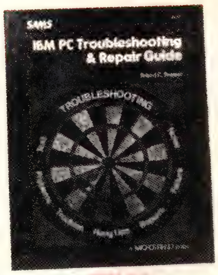

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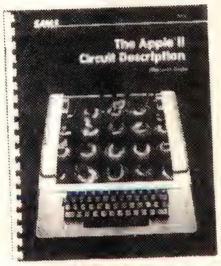

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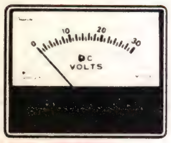

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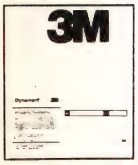

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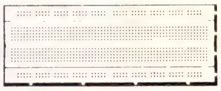

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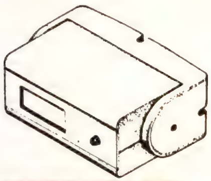

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74LS32	.70
74LS33	.70
74LS37	.70
74LS38	.80
74LS40	.80
74LS42	.60
74LS47	1.00
74LS48	1.00
74LS49	1.80
74LS51	.70
74LS54	.80
74LS55	.80
74LS63	2.80
74LS73	.60
74LS74	.60
74LS75	.60
74LS76	1.00
74LS77	1.00
74LS78	1.10
74LS83	.70
74LS85	.60
74LS86	.80
74LS90	.60
74LS91	.60
74LS92	.60
74LS93	.70
74LS95	1.20
74LS96	1.20
74LS107	.90
74LS109	.60
74LS112	.70
74LS113	.70
74LS114	.80
74LS122	1.30
74LS123	.90
74LS125	.80
74LS126	1.20
74LS132	1.50
74LS133	4.90
74LS136	1.50
74LS138	.80
74LS139	.80
74LS145	2.10
74LS147	2.50
74LS148	1.90
74LS151	1.20
74LS152	1.95
74LS153	1.00
74LS154	2.95
74LS155	1.00
74LS156	1.50
74LS157	1.10
74LS158	1.00
74LS160	1.00
74LS161	.80
74LS162	1.50
74LS163	1.10
74LS164	1.40
74LS165	1.50
74LS166	2.55
74LS169	2.45
74LS173	1.20
74LS174	1.20
74LS175	1.20
74LS181	4.00
74LS190	1.50
74LS191	1.20
74LS192	1.20
74LS193	1.20
74LS194	1.20
74LS195	.90
74LS196	.90
74LS197	1.75
74LS221	2.00
74LS240	1.90
74LS241	1.90
74LS242	1.90
74LS243	1.90
74LS244	1.50
74LS245	2.60
74LS247	1.30
74LS248	1.50
74LS249	1.60
74LS251	1.50
74LS253	1.20
74LS257	.70
74LS258	1.20
74LS259	1.50
74LS261	2.50
74LS266	1.20
74LS273	1.95
74LS275	6.80
74LS279	.60
74LS280	2.60
74LS283	1.50
74LS290	1.50
74LS293	1.30
74LS295	1.75
74LS297	6.50
74LS298	1.20
74LS299	3.90
74LS320	3.95
74LS321	3.95
74LS322	6.75
74LS323	6.50
74LS324	2.20
74LS326	2.20
74LS327	2.20
74LS352	2.20
74LS353	2.20
74LS354	3.95
74LS365	1.00
74LS366	1.00
74LS367	1.00
74LS368	1.00
74LS373	1.90
74LS374	1.90
74LS375	1.00
74LS377	2.15
74LS378	1.20
74LS379	1.90
74LS386	1.00
74LS390	1.80
74LS393	1.80
74LS395	2.00
74LS396	2.50
74LS398	3.00
74LS399	1.90
74LS424	5.50
74LS440	5.50
74LS441	5.50
74LS442	5.50
74LS443	5.50
74LS445	2.20
74LS446	5.50
74LS447	1.90
74LS448	5.50
74LS449	5.50
74LS490	3.20
74LS540	5.95
74LS541	3.95
74LS621	2.75
74LS622	2.75
74LS623	5.95
74LS629	5.95
74LS640	3.95
74LS642	2.75
74LS643	2.75
74LS644	2.75
74LS645	2.75
74LS668	1.75
74LS669	1.75
74LS670	2.75
74LS673	12.55
74LS674	12.55
74LS690	3.95
74LS691	3.95
74LS692	3.95
74LS693	3.95
74LS696	3.95
74LS699	3.95

74S SERIES

74S00	1.00
74S02	1.00
74S03	1.00
74S04	1.00
74S05	1.50
74S08	1.00
74S09	1.50
74S10	1.00
74S11	1.00
74S15	1.60
74S20	1.20
74S22	1.50
74S30	1.00
74S32	1.00
74S37	1.70
74S38	1.70
74S40	1.20
74S51	0.80
74S64	1.20
74S65	1.20
74S74	1.30
74S86	1.60
74S109	2.50
74S112	1.30
74S113	1.30
74S133	1.20
74S134	1.40
74S135	1.30
74S138	3.30
74S139	3.30
74S140	1.90
74S151	3.10
74S153	2.00
74S157	3.10
74S158	3.10
74S160	5.90
74S161	5.90
74S162	7.90
74S163	7.90
74S168	11.50
74S169	11.50
74S174	4.50
74S175	4.50
74S181	8.50
74S182	3.40
74S199AN	4.10
74S189	8.50
74S194	3.30
74S195	2.90
74S196/82590	4.90
74S197/82591	4.90
74S201	9.90
74S214AN	P.O.A.
74S225	10.90
74S226	7.90
74S240	6.90
74S241	6.90
74S244	9.90
74S251	3.90
74S253	4.90
74S257	3.30
74S258	3.30
74S260	2.90
74S274	P.O.A.
74S275	P.O.A.
74S280	5.90
74S281	P.O.A.
74S283	7.90
74S287	4.90
74S288	4.90
74S299	13.90
74S301	13.90
74S314	P.O.A.
74S330	P.O.A.
74S331	P.O.A.
74S373	9.90
74S374	9.90
74S381	9.90
74S387	3.30
74S412/8212	5.90
74S428/8212	7.90
74S470	9.90
74S471	9.90
74S472	9.90
74S473	9.90
74S474	9.90
74S475	9.90
74S482	11.90
74S489	7.90

8000 SERIES

8035	6.90
8039	7.90
8080	6.00
8085	9.50
8086	19.50
8088	19.50
8121	5.00
8123	4.00
8130	6.95
8131	5.95
8136	6.95
8155	6.50
8156	11.50
8185	37.50
81LS95	3.75
81LS96	3.75
81LS97	3.75
81LS98	3.75
8212	2.90
8214	4.90
8224	3.50
8226	4.90
8228	5.50
8237	19.50
8238	9.50
8243	8.50
8251	6.90
8253	7.50
8255	5.50
8257	16.50
8259	6.50
8272	33.00
8273	65.00
8274	42.50
8275	38.50
8276	28.50
8279	8.50
8282	6.90
8283	6.50
8284	8.50
8286	6.50
8287	6.50
8289	73.00
82S23	5.95
82S123	5.95
8303	5.50
8304	6.95
8311	5.95
8641	5.95
8741	57.50
8748	65.00
8749	58.50
8755	33.50
8820	6.95
8830	6.95
8832	6.95
8833	6.95
8834	6.95
8835	5.95
8T13	2.95
8T14	2.95
8T26	3.00
8T28	3.00
8T30	3.00
8T96	1.80
8T97	1.80

LINEAR

LH0002	9.50
LH0042CH	9.50
LH0070	9.50
LH0071	9.50
TL061	1.50
TL062	2.90
TL064	4.90
TL071	1.20
TL072	2.90
TL073	3.20
TL074	4.90
TL081	1.90
TL082	2.50
TL083	2.90
TL084	3.45
TL494	4.90
TCA220	9.50
TCA280	4.50
TDA1024	2.80
TA7205P	3.90
TEA1002	17.50
UAA170	5.95
UAA180	3.75
LM10CH	7.50
LM301	1.00
LM301H	1.50
LM302H	6.50
LM305H	1.50
LM307CN	1.00
LM308	1.00
LM308H	1.80
LM309K	2.90
LM310N	3.20
LM310H	3.20
LM311	1.00
LM311H	1.80
LM317T	2.50
LM317K	4.50
LM318	4.90
LM324	1.00
LM325	4.50
LM326	4.50
LM329DZ	.90
LM344Z	1.90
LM335Z	2.20
LM336 2.5V	2.95
LM338K	12.50
LM339	1.20
LM348	1.80
LM349	2.95
LM350K	10.50
LM351N	1.00
LM353	2.50
LM356N	2.40
LM357	2.40
LM358	1.40
LM361	3.50
LM377	4.90
LM378	6.95
LM380 8 pin	1.80
LM380 14 pin	1.90
LM381	3.50
LM382	3.50
LM383	5.95
LM384	3.50
LM386	1.95
LM387A	3.95
LM387	2.00
LM390	2.95
LM391	2.90
LM393	1.00
LM394CH	6.95
LM395T	9.95
LM396K	22.50
LF398	5.90
NE544	6.50
NE555	.60
NE556	1.20
NE558	5.00
NE560	4.60
NE567	2.00
NE570	5.90
NE571	5.90
NE592	6.90
NE594	9.50
LM709-14	1.50
UA710CN	1.00
LM711	1.20
LM723	.75
LM723CH	1.50
LM725	4.75
LM733	1.50
LM739	2.75
LM741	.60
UA747	1.30
UA748	1.00
MC1310	9.50
MC1312	7.95
MC1314	7.95
MC1315	8.95
MC1327	7.95
MC1350	1.95
MC1408L8	7.50
MC1437	4.95
MC1445	5.95
MC1456	1.95
MC1458	1.20
MC1466L	21.50
MC1469R	6.90
MC1488	1.20
MC1489	1.20
MC1494	8.40
MC1495	8.90
MC1496	2.50
LM1596	3.00
MC1648	8.90
LM1812	10.50
LM1830	3.90
LM2907	3.90
LM2917 8 PIN	4.90
LM2917 14 PIN	4.90
MN3001	17.50
CA3028	2.00
CA3046	1.90
CA3056	6.50
CA3059	5.95
CA3080	1.90
CA3086	1.90
CA3100E	7.95
CA3130E	2.90
CA3130T	3.50
CA3140E	2.20
CA3140T	2.95
CA3240E	11.95
CA3401	1.00
CA3900	1.20
CA3905	1.75
CA3909	2.95
LM3911	2.95
LM3914	5.90
LM3915	5.90
LM3916	5.90
LM3999Z	2.60
RL4136	1.95
RC4145	20.90
RC4194	3.90

CDP

CDP1802	16.50
CDP1864	17.50

CPU

6502	15.00
6502A	15.00
6522	15.00
6522A	15.00
6532	14.00
6551	12.90
6800	6.00
6802	7.00
6808	12.50
6809	10.00
6810	3.50
6821	5.50
6840	6.50
6845	12.50
6847	3.50
6850	7.90
6875	15.00
Z80CPU	5.00
Z80ACPU	5.00
Z80BCPU	12.00
Z80P10	4.50
Z80AP10	4.50
Z80CTC	5.50
Z80ACTC	5.50
Z80DMA	16.00
Z80ADMA	16.00
Z80AS10	13.00
Z80S10	13.00
AD570	69.50
AD590	9.50
AD7524	17.50
AY-3-8910	14.50
AY-3-2513	14.50
MSM5832	16.50
MM58174	19.50
MM5309	14.50
MM5369	4.95
FD1771	19.00
FD1791 (8876)	39.00
FD1793 (8877)	39.00
FD1795	39.00
FD1797	39.00
WD1691	29.50
WD2143	24.50
WD1931	22.50
WD1933	34.00
WD1983	14.75
WD1993	59.00
WD2123	26.50
WD8250	29.50
TR1602 (S1883)	8.50
TR1853	8.90
COM8116	24.00
BR1941	23.00
CRT8002A	59.90

MEMORY

2102	2.50
2114	4.95
2708	12.50
2716	9.90
2732	8.95
2764	7.95
27128	8.00
4116	3.95
4164	3.95
6116	5.00
6264	8.00
58725 (6116)	4.00
2101 (5101) (8101)	7.90
5101	7.90
8101	7.90
2532	12.50
27256	11.50
27512	29.50
41256	5.95

OPTO

4N25	1.50
4N26	1.50
4N27	1.50
4N28	1.50
4N29	1.50
4N30	2.00
4N32	2.50
4N33	2.50
4N35	2.50
4N37	2.50
MCT6	2.50
MCT66	6.90
MCT2	1.50
1LD74	5.90
1LQ74	6.50
FND507	2.00
TIL31A	2.95
TIL81A	2.95
TIL306	22.50
MAN72 (DL702)	3.50
MAN74 (DL704)	3.50
BPW50	2.25
CQY89A	1.95
HP5082-2811	4.95
HLMP 6620	3.95
LEDS	
3mm RED	.15
3mm YELL	.30
3mm GRN	.30
5mm RED	.15
5mm YELL	.30
5mm GRN	.30
5mm ORA	.30
RED RECT	.30
GRN RECT	.30
YEL RECT	.30
RED CHROME BEZEL	1.20
YELLOW CHME BEZEL	1.20
GRN CHRME BEZEL	1.20

SPECIAL FUNCTION

LM4250	2.45
NE5534N	3.95
NE5534AN	4.95
MC3340	2.90
MC3341	2.90
76477	8.95
76488	8.95
76489	9.95
8038	6.50
OM335	22.50
OM350	12.50
XR2206	8.95
XR2207	7.95
XR2208	6.90
XR2209	6.90
XR2211	7.95
XR2216	5.90
XR2240	6.95
XR2243	7.95
XR8038	7.50
95H90	8.50
11C90	16.50
LM7555	2.90
LM7556	3.50
MC10116L	1.50
LM13600	3.95
LF13741	.80
LF13741H	1.50
DM2502	22.50
SAK140	9.50
ZN414	1.95
ICL7106	19.50
ICL7116	19.50
ICL7117	21.50
ICL7611	6.95
ICL7660	5.90
ICM7211	12.50
ICM7216A	69.50
ICM7216B	69.50
ICM7226A	48.50
ICM7227A	19.95

ANALOG & DIGITAL

ADC0800LCN	22.50
ADC0801LCN	23.95
ADC0803LCN	7.50
ADC0804LCN	6.50
ADC0808LCN	14.95
ADC0820LCN	24.95
DAC0800	4.95
DAC0808	4.95
DAC0832LCN	6.95
DAC1020LCN	19.95
DAC1220LCN	19.95

TRANSISTORS

AC125	1.20
AC126	1.20
AC127	1.20
AC128	1.20
AC187	1.50
AC188	1.50
AC149	3.40
AD161	2.90
AD162	2.90
AF118	2.90
BC107	.50
BC108	.50
BC182L	.40
BC212	.30
BC318	.30
BC320	.40
BC327	.30
BC328	.30
BC337	.40
BC338	.40
BC546	.40
BC547	.20
BC548	.20
BC549	.20
BC550	.40
BC556	.40
BC557	.20
BC558	.20
BC559	.20
BC639	.50
BC640	.50
BCY70	1.90
BCY71	1.90
BD139	.60
BD140	.60
BD232	.90
BD233	.90
BD235	.90
BD236	.90
BD237	.90
BD238	.90
BD262	1.20
BD263	1.20
BD437	1.50
BD488	1.50
BD647	1.80
BD648	1.80
BD677	1.80
BD681	2.00
BD682	2.00
BDV64B	5.50
BDV65B	5.50
BDX63	6.50
Y96 (BUX 80)	4.90
BDY97 (BUX 80)	4.90
BF115	1.50
BF180	1.20
BF182	.90
BF183	.60
BF184	.60
BF198	.60
BF199	.60
BF200	1.20
BF245	1.50
BF337	1.50
BF338	1.90
BF458	1.00
BF459	1.00
BF469	1.20
BF470	1.20
BF494	.90
BFW10	1.50
BFW11	1.50
BFW16	1.50
BFY50	1.20
BFY90	1.90
BU126	2.95
BU208	4.90
BU326	3.90
BUX80	4.90
MFE131	2.90
MFE3001	9.90
MFE3003	6.95
MJ413	5.90
MJ802	7.50
MJ901	4.50
MJ1001	3.90
MJ11011	9.90
MJ11015	14.50
MJ11016	14.50
MJ15003	6.50
MJ15004	6.50
MJ15024	10.00
MJ2501	8.90
MJ2955	2.50
MJ3001	8.00
MJ4032	12.50
MJ4502	6.90
MJE340	1.50
MJE350	1.90
MJE371	2.90
MJE521	2.50
MJE700	3.50
MJE800	2.90
MJE2801	3.95
MJE2955	4.90
MJE3055	3.90
MJE13005	5.90
MJE13007	7.90
MJE13009	12.50
MPF121	2.50
MPF131	2.50
MPSA05	1.00
MPSA06	1.00
MPSA10	1.00
MPSA12	1.00
MPSA13	1.00
MPSA14	1.00
MPSA20	1.00
MPSA42	1.00
MPSA43	1.20
MPSA55	1.00
MPSA56	1.00
MPSA63	1.00
MPSA65	1.00
MPSA92	1.00
MPSA93	1.20
MPF102	.90
MPF103	.90
MPF105	.90
MPF106	.90
MPF109	.90
MPSL01	1.50
MPSL51	1.50
MPSU02	1.75
MPSU52	1.90
MPSU56	1.75
MP131	2.75
MRF221	19.50
MRF237	5.90
MRF238	29.50
MRF245	53.50
MRF455	37.00
MRF475	12.50
MRF603	19.50
MRF641	49.00
MRF646	53.00
MRF901	2.90
MPF131	1.90
TIP31A	1.00
TIP31B	1.00
TIP31C	1.00
TIP32A	1.00
TIP32B	1.00
TIP32C	1.00
TIP41C	1.90
TIP42A	1.90
TIP42C	1.90
TIP49	1.90
TIP50	2.20
TIP53	2.50
TIP111	1.50
TIP112	1.50
TIP116	1.50
TIP117	1.50
TIP120	1.50
TIP122	1.50
TIP125	1.50
TIP127	1.50
TIP145	3.40
TIP2955	3.50
TIP3055	3.50

2N

2N301	4.00
2N697	1.00
2N918	1.00
2N1304	1.00
2N1613	1.20
2N2102	1.90
2N2219	.90
2N2222A	1.00
2N2369	1.00
2N2484	1.00
2N2646	1.95
2N2647	3.95
2N2894	1.00
2N2904	1.10
2N2905	1.10
2N2906	1.10
2N2907	1.10
2N3019	1.90
2N3053	.90
2N3054	1.90
2N3055	1.20
2N3096	1.20
2N3109	1.90
2N3251	1.90
2N3302	1.90
2N3440	1.80
2N3441	2.90
2N3442	3.50
2N3563	.30
2N3564	.30
2N3565	.30
2N3566	.30
2N3567	.30
2N3568	.30
2N3569	.30
2N3638	.30
2N3640	.30
2N3641	.30
2N3642	.30
2N3643	.30
2N3644	.30
2N3645	.30
2N3646	.30
2N3702	1.20
2N3704	1.40
2N3739	4.50
2N3771	5.50
2N3772	5.70
2N3773	5.90
2N3792	6.00
2N3819	1.20
2N3866	2.95
2N3904	1.00
2N3906	1.00
2N4030	1.50
2N4032	2.20
2N4033	2.20
2N4036	2.50
2N4121	1.50
2N4123	1.50
2N4236	1.90
2N4237	1.90
2N4248	.40
2N4249	.40
2N4250	.40
2N4258	.50
2N4355	.50
2N4356	.50
2N4360	1.00
2N4401	.30
2N4402	.30
2N4403	.30
2N4416	1.90
2N4427	3.90
2N4919	2.90
2N5088	1.00
2N5089	1.00
2N5139	1.20
2N5179	1.20
2N5190	2.50
2N5191	3.30
2N5192	3.10
2N5193	2.50
2N5194	2.95
2N5195	3.30
2N5210	1.50
2N5245	1.50
2N5303	8.50
2N5401	1.50
2N5457	1.00
2N5458	.90
2N5459	.90
2N5461	.90
2N5462	.90
2N5485	.90
2N5486	.90
2N5489	14.50
2N5590	26.50
2N5591	29.50
2N5641	19.50
2N5656	2.50
2N5770	.30
2N5777	1.50
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CONVERSATIONS WITH BOSE —

Amar Bose, doyen of loudspeaker manufacturers flew into Sydney recently to boost the morale of the local troops and mastermind the launch of the new project X speakers. On the way, he met ETI for lunch.

Jon Fairall

Amar Bose strides across the floor to greet you; six foot two and greying wavy hair that would give him a distinguished look even if he wasn't the head of a major US company with branches all over the world. I was prepared for that, perhaps a trifle less prepared for the slightly donnish curiosity with which he looked at his surroundings ("terrible accoustics in here").

No matter what you bias, Amar Bose confounds expectation. A modern version of the renaissance man, he is the hi-fi buff *par excellance,* a teacher of electronics and maths, a businessman and marketer. None of these is exceptional on its own, but as a combination its highly unusual, even more so because Bose has been successful in every field he has touched. Today he is the world's biggest amplifier maker, probably the most revolutionary speaker designer, and incidentally, author of a standard undergraduate text on Network Theory. Bose is an interesting character.

Where it all began

It all began at age 13 when some friends in the Boy Scouts were looking for a communications device. From that he learnt how to read a schematic, and by age 14 he had opened a radio repair shop. As Bose recalls it, competition was limited since almost all the adult radio repair men were away in the war. Money was good and young Amar was the envy of his friends. It obviously didn't detract from his studies either, because he came out of school with results good enough to get into the Massachusetts Institute of Technology (MIT), then as now, one of America's better universities.

He graduated during the early fifties with a doctorate in electronics, and was all set on a career as a typical academic electronics engineer when he had the Seminal Experience. Bose has told this story a hundred times but he still manages to look rueful as he recalls how he wanted to buy a hi-fi, and proceeded to buy it the way "any engineer would". He looked at the specs., and then, imagining that the salesmen would have little to tell him, went in to the store and demanded the amplifier, speaker and turntable that looked best on paper. He bought some records and invited some friends over for an evening to listen to good music. "We never finished the first record," he says. The sound was terrible, and Bose was curious. He went back to the store and this time listened to speakers. What he discovered was that there was little relationship between the specifications and the sound he heard. The scientist and the music lover rebelled.

> ***"in 1956 he thought he knew everything. By '59 he knew he knew nothing."***

That was in 1956. Bose spent the next twelve years trying to find out what the problems were, and how to put them right. By 1959 he had sorted out what speaker makers were doing wrong; it took until 1968 to design the first Bose speaker that embodied his new found knowledge on what made hi-fi speakers tick.

As Bose describes it, in 1956 he thought he knew everything. By 1959 he knew he knew nothing. Today, he says, he may have some glimerings of understanding. By subjective testing, scientific analysis, statistical tests and the battery of intellectual tools a doctorate in electrical engineering gives one, Bose deduced a number of things. Many are still secret, and the basis of much uncopyable Bose design, but much has appeared in scientific publications over the years as well. He discovered, for instance, that the human ear is totally unresponsive to the phase relationship between different frequencies; that amplifier transient response is essentially irrelevant to the sound perceived and that the experience of music played live depends almost totally on the delay caused by the many different reflection paths experienced in an enclosed space.

He also discovered that the traditional way of measuring speaker response, which is in an anechoic chamber with a mike directly in front of the speaker, will tell you nothing about how a speaker will perform in a real environment. At an absolute minimum a real environment will have a floor. Commonly it has walls, and sometimes even a corner. These effect the way in which sound reflects back to a listener. Whats more, all frequencies are not affected equally. Rather what happens is that low frequencies are reflected more than high frequencies. Thus a speaker that had a completely flat response from 20 Hz to 20 kHz in an anechoic chamber would have a quite diabolical response, perhaps varying by as much as 20 dB, in a live situation.

First Result

In 1959 the world saw the first result of the Bose rethink of sound. It was a commercial failure called the Model 2201, and consisted of 22 small drivers sitting in a box shaped like an eighth of a sphere. Although it performed extremely well, it was more expensive than the market would stand, and was replaced by a strange device that had one tiny driver facing forwards, and four facing backwards. It was called the Model 901.

The 901 and its derivitives made Bose's

name, and set a fashion with Bose speakers, in which the drivers, although many, are never divided up conventionally into woofers, tweeters and so on. Because the distance between the drivers is small with respect to the wavelength of a base note, the small drivers act together as if they were a very much bigger driver.

Since then there have been a sucession of other developments, probably the most notable being his deal with General Motors which called for Bose to put speakers and amplifiers into GM products. Overnight, Bose became the worlds biggest amplifier producer, since each GM car now comes equiped with a Bose amplifier. It's no mean amp either, since it's required to dissipate considerable heat in an extremely hot environment. Bose engineers were able to develop a 50 Watt amplifier on a 50 square centimeter board without any heatsinks by using a novel modulation system.

Noise supression

When I met him he was also bubbling over the success of his noise supression equipment. It had been used to protect the hearing of the crew of the long distance aircraft "Voyager", which flew around the world in nine days. Preflight medical advice to the crew was that the result of subjecting themselves to the 100 dB noise of the aircraft in flight for nine days without a break would be a permanent hearing loss of about 30%. Bose designed special ear muffs. The first problem was to make them comfortable enough to wear for nine days straight, which apparently he did. Secondly he developed a structure that gave them 30 dB of attenuation to the main components of the engine, and finally, an electronic noise reducing circuit which analysed the noise present at the ear, and then cancelled it using a 180 degree phase shift approach. This technique has been tried before, with a notable lack of sucess for the most part, but Bose was able to refine the method to such an extent that the crew suffered no measurable hearing loss at the end of their flight.

> “ *most people are intimidated by boxes full of complex knobs* ”

Project X

The big thing on the go at the moment is the Project X speaker system. These will be the subject of review in the near future in ETI, so I wont preempt it to much here. Suffice to say Project X departs from normal Bose design in having the speakers divided up into frequency components. It consists of two tiny mid range/tweeter boxes, each about 100mm on a side, and a single subwoofer. The small speakers are themselves interesting designs, having a claimed response curve that goes down to 200 Hz. The woofer, however is really radical. It consists of a closed box with two ports in it. No driver is visible. Apparently, there are two normal drivers in it, which are coupled to the outside air through the ports, one port to the front surface of the drivers, and one to the back. Not only does this give an enormously amplified base response at the resonant frequency of the amplifier, but it also gives extremely good attentuation of frequencies above the resonant frequency. Since most of the distortion components are produced above this frequency, Bose claims they will always be essentially inaudible.

Beyond Project X? I asked Bose about the future of hi-fi. Currently, the industry is suffering a slump world wide, and there is not a lot to be confident about. He reasons: hi-fi penetration in US households is only 30%, even when hi-fi is loosely described only as the existance of separate speakers in the house. The figure for Australia is not much different. The reason: most people are intimidated by boxes full of complex knobs, so any future expansion of hi-fi will have to be by providing people with simple equipment possessing good sound qualities. "For too long people have listed to equipment. We want them to start listening to music". ●

MADE IN TAIWAN

To most of us in Australia, Taiwan is an electronic industry success story. But it's taken some government initiative and dedication.

Thomas E. King VK2ATJ

Taipei's World Trade Centre, one of the largest exhibition centres in Asia, displays nearly every product that the economically booming island province of the Republic of China produces.

While Taiwan's 36,188 sq km doesn't even give it a place among geographic giants this tiny Asian isle, just 5500 km north of Darwin, is truly an electronic Titan. Taiwan, on the Republic of China, exported a staggering $12.3 billion worth of electronic products to over 130 nations last year. With figures expected to top the record breaking $15 billion mark this year, it's an even more staggering achievement when the phoenix-like beginning of Taiwan's electronics industry is considered.

Before World War II, the tobacco leaf-shaped island's economy was agriculturally based, although some small scale industries had been established. During the five year period following the war emphasis was placed on the rehabilitation and reconstruction of damaged factories and work sites. For 10 years to 1960 the stress on the development and construction of import-substitution industries was aimed at the production of consumer goods to satisfy increasing domestic demands.

During the next 10 years, from 1961 to 1970, efforts were concentrated on the development of export oriented industries. This decade which experienced the birth of many company names now common around the world also saw an enormous demand for raw materials. Because of this, the government, during the years 1971 to 1980, encouraged the establishment of capital intensive heavy industries and petrochemical industries to produce raw materials and intermediates to substitute for imports.

During the third full decade of industrial development, Taiwan's business people have had to respond to several late 20th century peculiarities: fluctuating oil prices, keen competition of light industrial products among developing nations and the adoption of a protectionist attitude by many developed countries. To date efforts have been made to develop strategic industries such as machinery and information industries which have low energy demands but are of high tech sophistication.

Developments

Because the electronics industry satisfies these conditions and because the government has provided a number of incentives it's not surprising that in 1983 electronic products and electric machinery replaced the traditional textile industry as Taiwan's largest export earners. (The electronics industry is now responsible for over 20 per cent of the country's total export revenue). The electronics industry today provides a firm foundation for many other high-tech sectors; all are undergoing extensive research and development programs according to data obtained from the Industrial Development Bureau, Ministry of Economic Affairs.

Computers and related products

Personal computers, floppy and hard disk drives, printers and local area networks have been developed and efforts are being made to develop minicomputers, work stations, larger hard disks and printers.

Computer software

Operating systems, software packages, software tools, and Chinese character codes for information exchange have recently been or are undergoing development. More than 100 specialized manufacturers develop computer software, 15 of them have their software available for export.

Electronic components

VLSI is being researched and developed. Major results are expected in the development of LED, LCD, multilayer pcb's and flat panel displays.

Taiwan is currently the world's largest supplier of 1 to 3 amp general type, and low powered, fast recovery rectifiers and the fourth largest pcb supplier behind the USA, Japan and West Germany.

Electronic communication products

Optical fibre communication systems, facsimile and microwave systems are being developed to strengthen the use and development of computer and communication products.

Electronic industrial systems

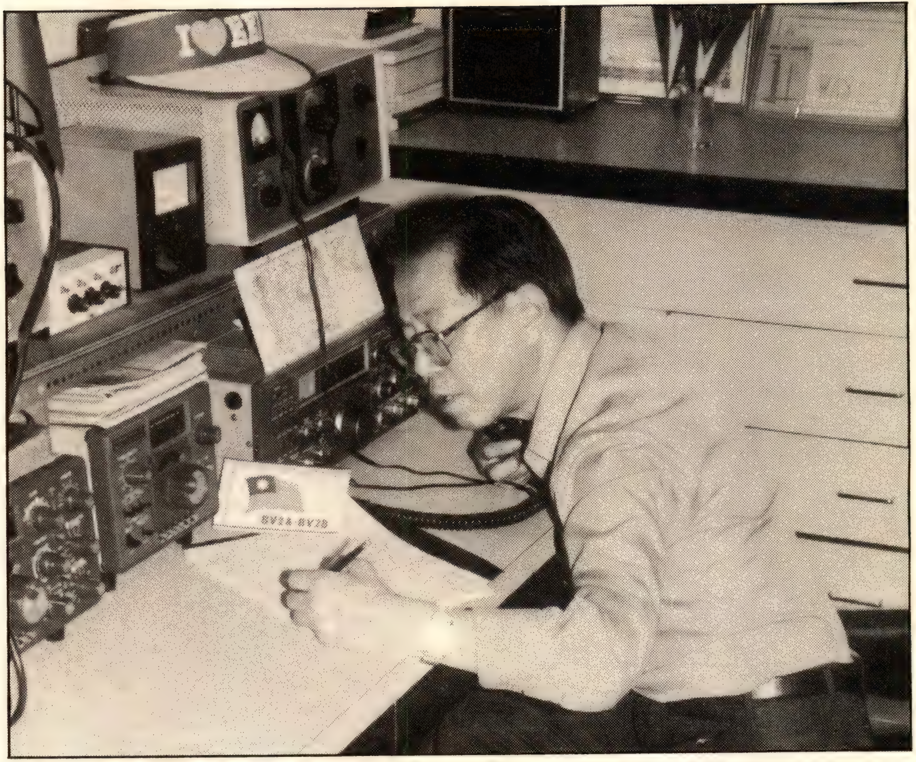
In this sector, research and development is being focused on electronic instruments and industrial robots.

Consumer electronic products

The prototype of digital TV has been completed. Research and development efforts are being placed on VCRs, digital audio players and video disc players — items eligible for investment encouragement by the government.

(To effectively promote the private electronics industry, Taiwan's Industrial Development Bureau has embarked on a multifaceted program to encourage foreign investment in Taiwan. In order to stimulate private enterprises to enlarge their R&D programs, a matching fund is available to organizations and businesses conducting R&D exercises. The Electronic Research and Service Organization and the Institute for Information Industry will act as operating agencies to link together the efforts of the government research organization and private enterprise. Details of this program are available locally from the Far East Trade Service Inc, Branch Office in Sydney, Suite 3508, MLC Centre, King Street, Sydney, NSW 2000. (02) 232-6626.)

Photographs: Thomas King.



Although Tim Chen has been interested in amateur radio for nearly 50 years — the last 26 from Taiwan — the enthuastic hobbyist is still active on the bands.

Because their annual export of consumer electronic products has accounted for more than half of total exports in the electronics category, and because an increasing number of these items are finding their way to Australia, it is worth taking a look at this mushrooming aspect of the industry. From a starting point in 1961 when Taiwan established its first transistor radio plant, the electronics industry has grown to encompass 1000 manufacturers producing products as diverse as simple AM radio's and mini TVs to compact disc players and satellite receiving systems.

Television

The television set industry was established in Taiwan in 1962 when the first TV station began transmission. In 1982 Taiwanese black and white TV manufacturers found their sets were beginning to lose international competitiveness and so started shifting investment and outlook to the production of computer monitors.

Colour broadcasts and the production of colour sets began in 1969. The NTSC system was adopted to meet TV set demand in major export markets. In 1984 manufacturers started making PAL units after receiving long-sought-after authorization. This greatly helped to expand and diversify Taiwan's export market for colour sets.

It is hoped that two new developments will further boost the television industry in the next few years. Digital TV developed in late 1985 has brought vast improvements have been made in resolution and picture fidelity. Perhaps even greater economic potential will be realized when 'picture in a picture' TVs (simultaneous display of two pictures of different sizes on the same screen) are commercially produced.

Video cassette recorders

Although a relative newcomer to the Taiwan electronic scene with first models released in 1982, the market potential for VHS and Beta VCRs and VCPs is considered to be very great. ▶

Audio equipment

This equipment now represents the single most important part of exported electronic products. Radio set production in every conceivable style from multi-function units to sets in sunglasses, amounts to between eight and nine million sets a year. Mini three-in-one systems incorporating a small TV set are the latest entry on the export market. These haven't been received in Australia yet but a 4½" mini TV set has been found commercially successful.

One of the biggest selling audio items is the CD player. Again it's an electronic newcomer with the first prototypes appearing in 1984 and commercial exports beginning only in 1986. Production technology and vital components such as laser pick-ups have to date been sourced from leading Japanese suppliers and Philips of the Netherlands.

Japanese-made CDs have so far dominated the market but with lower labour costs and the yen's meteoric appreciation, Taiwanese manufacturers have been able to internationally compete by offering CDs of comparable quality and at very competitive prices. (The strengthening of the yen, low labour costs, foreign investment, confidence and technology transfer, an emphasis on research and development, increased quality control and the government's declaration to enact legislation for the protection of intellectual property and copyright are all working in Taiwan's favour to markedly increase the technical standing of its products as well as its export earnings.)

Video tapes and audio tapes

These magnetic products are experiencing rapid growth in both the domestic and export markets. Demand for tapes is greatest in the USA, Hong Kong, Canada and Japan. This is in line with the country's overall electronics export breakdown with West Germany, Singapore, Holland and the United Kingdom completing the 'big eight' — the major importers of goods made in Taiwan.

Telephones

Like other segments of the electronic industry, Taiwan's telephone manufacture is improving in quality with a move from a labour-intensive base to a technologically capital-intensive base. Telephones have progressed to the latest in high value added telephone sets with special functions. An integrated household telephone system has been developed which incorporates a burglar alarm, computer terminal and closed circuit VTR in the single unit.

Calculators

Calculators have been manufactured since 1972. The export volume exceeded 10 million pieces in 1981 for the first time. Emphasis nowadays is on solar-powered models which experts say will replace the traditional battery operated units in the not-too-distant future.

Shows

Whether it be the latest solar powered calculator, the newest three-laser CD or prototypes of digital TVs, Australian visitors can see them all and much more at two large electronics related trade fairs set for 1987. Computer Taipei, the Taipei International Computer Exhibition is set for June 8-14 while the Taiwan International Electronics Show is being organized from October 6-12. (Details are available from the Far East Trade Service Office in Sydney.)

Both of these events which attract between 200 and 500 participating exhibitors are annually organized by the trade promotion agency, the China External Trade Development Council (CETDC) and the Taipei World Trade Centre. The globe-encompassing China Airlines also assists in numerous ways as the official carrier for all Taipei trade shows.

> “
> ***Radio sets production in every conceivable style from multi-functional units to sets in sunglasses.***
> ”

The venue for these trade shows (and a host of other world-class trade fairs ranging from machinery and sporting goods to leather goods and furniture) is the 46,000 sq metre World Trade Centre. Located near the Sung Shan Domestic Airport in east Taipei, the centre is part of a $750 million redevelopment project.

The main hall of the seven-storey centre can contain 1330 short term exhibition booths. In the centre is an enormous skylit atrium the size of six football fields where tall exhibits such as yachts and cranes can be shown. The second to sixth floors house nearly 1100 export sales and display shops for local exporters and manufacturers. The entire product spectrum of Taiwan's electronics industry can be seen here. In addition, a permanent Export Products Display Centre on the second floor contains some 1833 tiny enclosed stalls where still more goods are on display. (These are unmanned static displays which are changed every six months.) After touring this ultra modern complex, it's much easier to understand the very important role that the electronics industry has played in helping Taiwan achieve the rank of the 11th largest exporting nation in the world.

Amateur radio

While it's impossible to determine the sole individual responsible for either the start or the development of Taiwan's electronics industry such is not the case when it comes to amateur radio on the island nation. The number one ham title goes to Tim Chen, an enthusiast whose affinity with the hobby dates back nearly 50 years. During that time he has held the exotic calls of XU6A, C3YW, and since 1960 has been the trustee of BV2A (Kaohshung) and BV2B (Taipei), the club stations of the 4000 member strong China Radio Association.

Tim was the lone amateur voice from Taiwan for nearly 25 years until an Italian amateur radio group succeeded in obtaining permission from the Ministry of Communications to operate a five day DXpedition in late 1983. In early January 1987 the eighth DXpedition — consisting of a group of Japanese amateurs — operated for the first time from Tainan, Taiwan's third largest city.

Nowadays, these short but highly intensive radio sessions are complemented by regular operations from 14 licensed and fully equipped amateur stations. Call signs include the two club stations; BV2s, DA, FA, GA; BV5s GA, HA; BV61A and BV7s JA, KA and LA. A BV8 station on the eastern coast of the island is expected. BV9 is assigned to off-shore islands although no individuals from these remote beauty spots have yet appeared for the exam administered by the Department of Licensing and Regulations.

Only one exam has so far been conducted, although with the government's declared support of the hobby the second one is expected this year. Tim's wide amateur experience will likely again be called upon in preparing the test papers which form the basis of the day-long exam of electrical and electronic theory, international rules and regulations, English communications, geography and Morse sending and receiving at 13 wpm.

Although amateur radio is a relative newcomer to the Republic of China this hobby is destined for a bright future. With continued government encouragement not only will new friendships be forged between Taiwan and the peoples of the world but the emerging pool of well trained enthusiasts will incalculably assist the nation in meeting the electronic challenges and opportunities of the 21st century. ●

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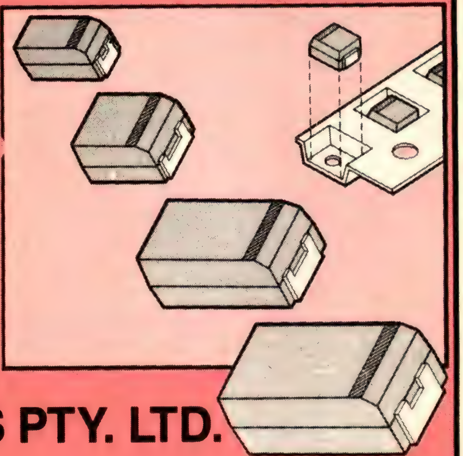

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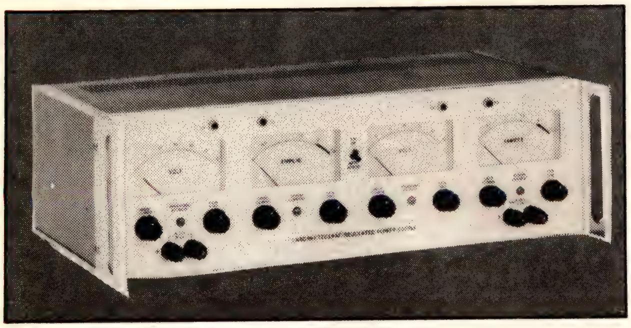

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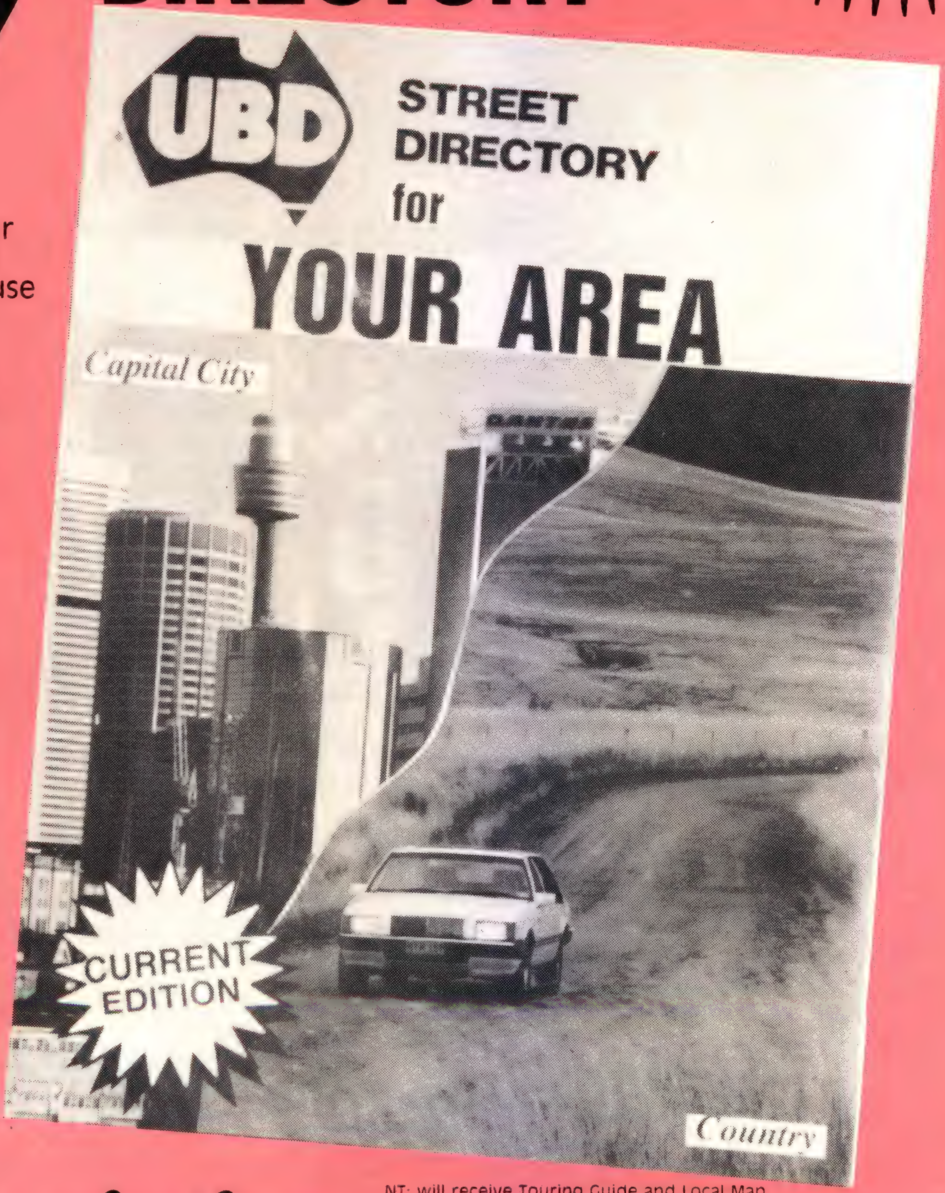

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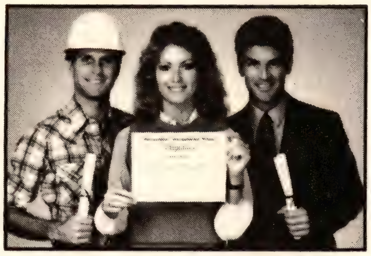

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Kiwisats

Satellite broadcasting comes to New Zealand with the singing of a contract between the NZ post office and Aussat. This is how the Kiwi's will use their new capacity

Alan Concannon

Early in 1986, the New Zealand government's Communications Advisory Panel (CAC) undertook two studies into satellites and their future in New Zealand. Both studies concluded that the country must acquire a satellite capacity, although it tempered its report with a sobering analysis of the economics of satellite usage, especially given the foreign exchange and other economic problems of the country.

One study concentrated on communications satellites. The CAC strongly recommended exploratory negotiations with Aussat and Intelsat for domestic television, direct broadcasting, and other services.

The other study dealt with remote sensing satellites. The CAC recommended that the government should give this the highest possible priority because of its importance to the nation's economy. They also concluded that New Zealand would need its own satellite receiving station.

As a result, in November 1986, New Zealand Post Office signed a contract with Aussat for a special transponder on the Aussat K3 satellite which will be the most Easterly of the three Aussats. K3 is designed to pick up some of the Australian capacity which has overflowed from K1 and K2, but more importantly, to provide communications channels into the South Pacific. When it finally flies (See box), K3 will provide New Zealand with TV reticulation, video conferencing and other communications services.

All members of the CAC agreed that there would be major benefits in using satellites in domestic telecommunication networks. However, within the immediate future most felt would not be sufficient demand to justify a satellite exclusively for New Zealand's requirements. The report also mentioned areas of the NZ Post Office that could benefit by a satellite system. These include:

- Telecommunications trunk routes: A satellite system would provide route diversity and ensure continuity of telecommunication services, especially during a microwave system failure. It would also assist with the growth of the telecommunication network, especially with unusual traffic expansion or geographic needs. The CAC envisaged that as existing equipment needs replacing, a new system using satellites will be phased in.
- Telecommunications Services in Difficult Areas: A satellite system would provide telemetry circuits — especially receiving data and information from remote collecting sites. Communities in remote and difficult areas could also reap the benefits of improved telecommunications. Emergency Communications like Civil Defence, Search and Rescue, Police operations, etc, would all find a vast improvement using a satellite facility.
- Television: A satellite system would assist with the distribution of network television programs to local transmitters.

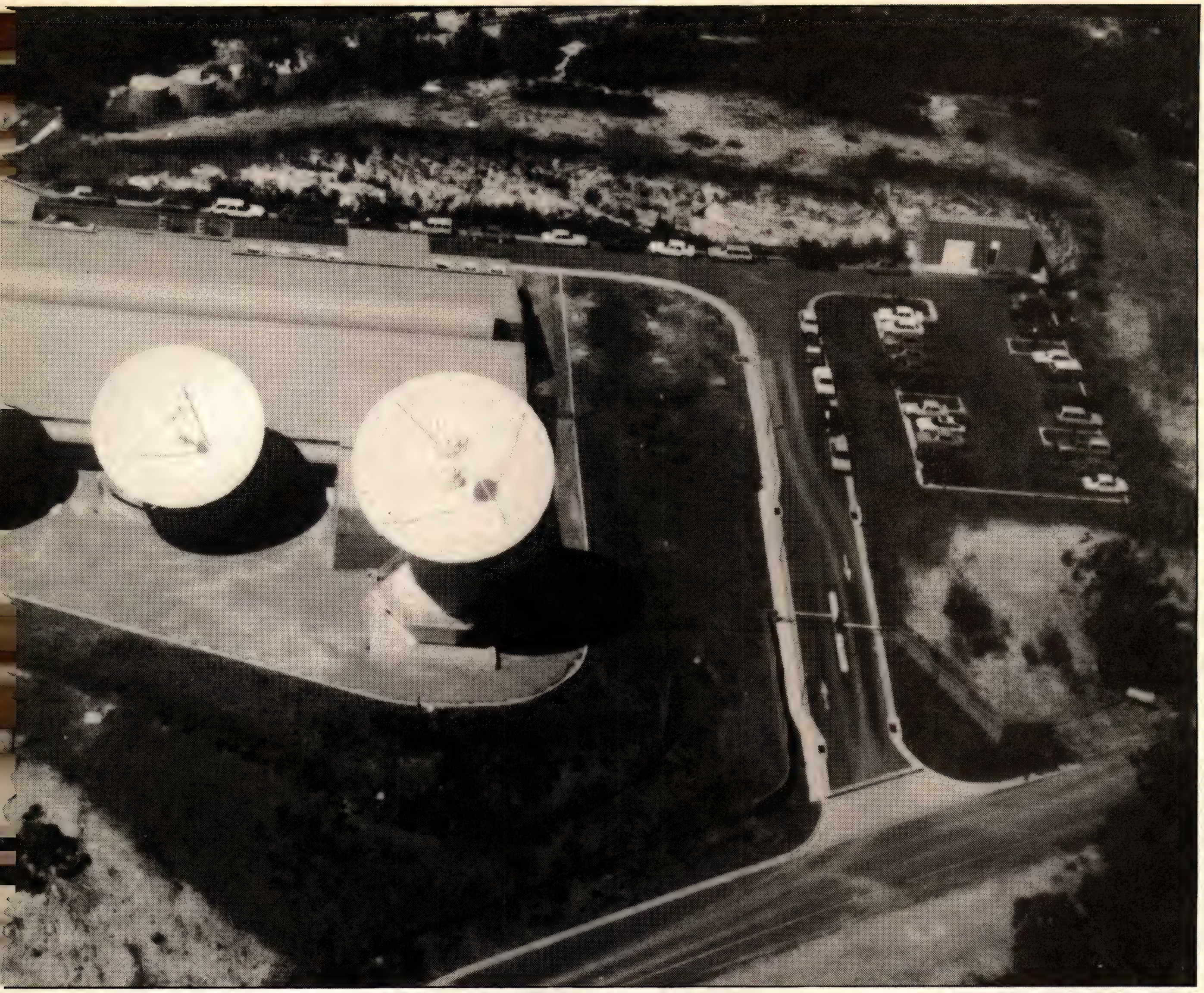
Currently, TV programs are produced on two channels in Auckland, Wellington, Christchurch and Dunedin, and then transferred over land to transmitters throughout the country. A satellite system would increase route diversity and also spread reception of the second channel which was introduced in 1976, and still does not reach all the country.

If the satellite were used for TV reticulation, it would also simplify arrangements for the introduction of a third channel. Currently this is under discussion in New Zealand as a fully commercial channel, but it could also be implemented as a pay TV channel, for which BMAC, the Australian TV standard, would be ideal.

The report also looked into Direct Broadcasting from Satellite (DBS) and the possibility that it might be an option within the next decade. DBS, in which a television signal is transmitted from the satellite direct to the subscriber's home different from other communications systems. It is a prerequisite of such a system that the home terminals required by viewers must be made small and inexpensive if the service is to be a success. To satisfy this condition the satellite broadcast signal must be many times more powerful than that required for other forms of communications. This means in principle, DBS will take most of the available bandwidth on a satellite, and thus, must be held responsible for most of the cost.

In addition to this financial disincentive, DBS is not technically practical except in the same way as they are provided in Australia, i.e: by large and expensive down stations. The CAC had hoped that some DBS capacity would be made available on the second generation Aussat satellites to fly in 1991, but it seems that any possibility of high powered transponders evaporated with the release of tender documents which showed an Australian commitment to a lot of relatively low power transponders. Intellsat is no better. The CAC looked at the possibility of using a proportion of the next generation Intelsats booked for the Pacific, but concluded they would not be viable.

However, the use of a satellite and DBS



The AUSSAT station at Belrose NSW.

is not a foregone conclusion even in the long term. It's just one of several technologically feasible options that might come of age within the next few years. Others include UHF broadcasting and cable. The UHF band is particularly attractive because, unlike Australia, it is completely unallocated for TV use. However, the committee did note that the technology of direct broadcasting is advancing rapidly. It may well be economically feasible within the next few years to provide nationwide coverage at a fraction of current costs, even when taking into account the fact that the cost of additional household receiving equipment is unlikely to drop below half the cost of a television receiver.

The report says that if the Government accepts there is a case for extended television services, given present economic circumstances, then in the short and medium term the terrestrial broadcasting bands should be fully and effectively utilised. Initially the UHF band should be developed for local, regional commercial or pay television in urban and provincial centres.

The NZ Post Office, the CAC decided, should be responsible for all satellite telecommunications services, including distribution networks for television. However, since the Post office is a monopoly, there should be a commitment to provide satellite services for small or even part-time users such as civil defence, search and rescue and so on. ●

The fortunes of Ariane

As we go to press, news has come in that Aussat K3, the last of this generation of Aussat satellites, is to remain firmly geostationary at Ourou in French Guyana. After the failure of an Arianne IV in the middle of last year, the Europeans abandoned their launch schedule pending an enquiry into what went wrong. Engineers quickly isolated the cause of the trouble as the new cryogenic motor used in the third stage. It appears it ignited and then went out like a damp squid, leaving launch officials with no alternative but to destroy the rocket and its cargo of communications satellites. To date, no complete understanding of the problem has come forward.

This situation left Aussat feeling somewhat miffed, as K3 was the next load due to fly. Hasty consultation with Ariannespace, the operators of the rocket, left Aussat officials confident of a launch in January. Then February. Then March. Now it appears that the troubled rocket may well stay on the launch pad until July.

Meanwhile Aussat is beginning to count the losses in unserviced contracts as the months pass with only 2/3 of planned capacity. The uncertainty around Arrianne has also fuelled a new round of price hikes in premiums as insurance companies react to the increased risk of failure.

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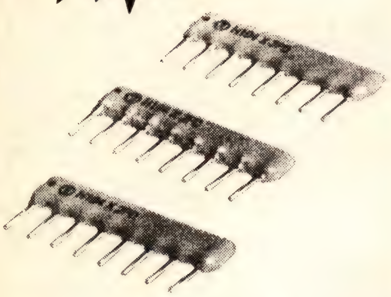

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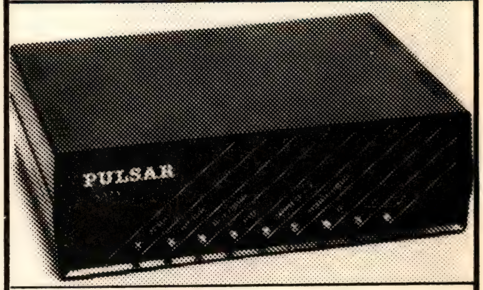

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HOW DOES THE HUMAN COMPUTER WORK?

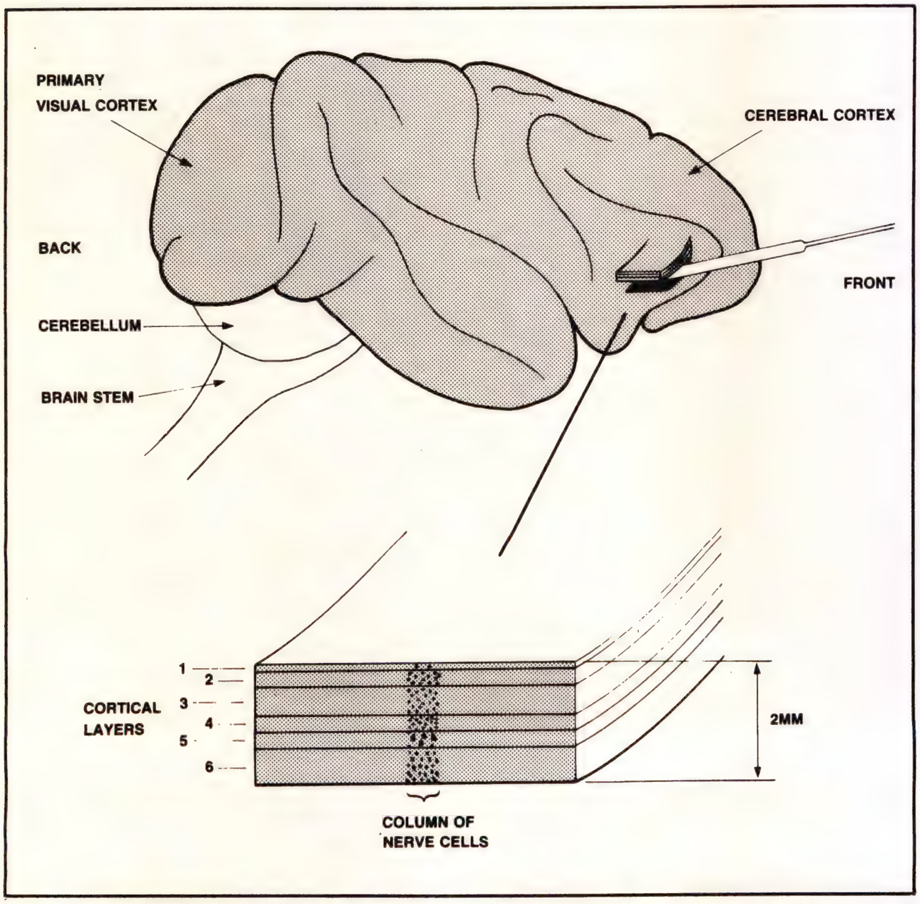
The human brain is a triumph of miniaturisation, the most remarkable computer in the world. Yet its nerve cells process only 100 or so instructions per second in contrast to the millions that a computer may handle. This makes the speed at which we perform very complex operations all the more astonishing.

Dr Kevan Martin *

Computers are now part of our daily lives. We see them at work in shops at the checkout till, they dispense money to us outside banks, they produce our utility bills and they are replacing typewriters for tasks such as writing this article. They tackle complex arithmetic with an accuracy and speed that no ordinary human can hope to match. The rate at which they have proliferated to occupy almost every niche of our existence, in the home and workplace is a tribute to their flexibility of operation.

In our admiration for the electronic marvel we perhaps forget that the most powerful computers in the world are not built of silicon, but are carbon-based. Each of us, in fact, owns one of those computers; they come built-in at birth and operate unceasingly, often for well over 70 years. It is, of course, the human brain.

Unlike the silicon chip, our brain has evolved over millions of years and, because it is always with us, we often forget how powerful it really is. It is only recently that attempts to simulate human behaviour using computers have revealed how difficult many of the tasks are that we perform with ease. The speed at which we can carry out very complex operations is all the more astonishing when we consider that a computer can process millions of instructions per second, against 100 per second or fewer for the average nerve cell.



The brain of a monkey seen from the side. Much of the cortex lies buried in deep folds. If a piece of cortex is dissected away from the underlying fibre connections its laminated structure can clearly be seen. The width of a column of cells with similar functional properties varies from about 0.05 to 0.5 mm, depending on the property.

Processing Visual Information

One of the most complex tasks we perform is that of visual perception, and this has been a major area of investigation over the last 25 years. We now know that the main processing of visual information goes on within an area of the brain called the cerebral cortex. In primates, including humans, the cerebral cortex is so well developed that it covers the rest of the brain and, with its connections, forms over 80 per cent of the brain's volume.

The cortex consists of a sheet of nerve cells 2 mm thick and about one-seventh of a square metre in area. In humans the cortical sheet has to be folded many times to fit inside the skull; this produces the very convoluted surface of the human brain.

The primary visual processing areas of the cerebral cortex lie at the back of the brain, but the positions of the many other visual areas that undoubtedly exist in humans have yet to be found. In other primates, such as monkeys, these other visual areas have been mapped and it turns out that about 40 to 50 per cent of their cerebral cortex carries out visual processing. That so much of the brain is occupied with visual processing is perhaps not surprising, when we consider how much we depend on our eyes for normal living.

The first stage in visual processing takes place in the eye, where the retinal receptors sample the visual world and transmit the information to the visual cortex *via* an intermediate structure called the thalamus. Each receptor in the retina 'looks' at a small piece of the visual world and signals changes in contrast, such as the difference between black letters and the white page of this article. In many vertebrates, including ourselves, the retina contains a mix of receptors, all of which are selectively responsive to light of a different wavelength. The information they provide is used for the interpretation of colour.

While almost any visual stimulus activates the retinal receptors, the nerve cells in the cortex are much more selective in their responses. Intensive study by the Nobel-prizewinning scientists Professor David Hubel and Professor Torsten Wiesel of Harvard Medical School showed that most of the cells are selective for the orientation, shape, size and direction of movement of a visual stimulus. Cells with similar preferences are grouped together in columns extending through the full thickness of the cortex. Clearly this sort of functional organisation must reflect an underlying organisation of the cortical circuitry. However, analysis at this level is unable to tell us very much about how the cortex is put together and programmed any more than we can understand a computer by exploring its word-processing capacities. Nevertheless, in the same way that the circuitry and logic of the computer determines its capabilities, so our understanding of how the visual cortex performs its tasks depends on how much we can find out about the contents of the cortical 'black box'.

One of the main problems we face is the sheer number of components involved. Each square millimetre of cortex covers about 100,000 nerve cells. In primates, the primary visual cortex alone probably contains about 320 million nerve cells. As if this is not enough, there are many different types of nerve cells and the cortex is further divided into six basic layers containing different densities of these types. Nevertheless, there appears to be one important simplifying principle in the design of the cortex: it is a modular system. This means that, at least at its most basic level, particular structural patterns are repeated again and again.

Our task, then is to uncover the structure of the cortical microchip, and how it works. There are two strategies we might use. The first is to watch how they form, unit by unit, by studying the development of the nerve connections during early life. The second strategy is to take the complete adult circuit, select one element, for example a single nerve cell, and find out its position in the circuit and what it does.

Using the second strategy, we examined the input to the cortex from the thalamus. Each nerve cell in the thalamus sends a single fibre to the cortex, and the fibres travel to the cortex in tracts known as the white matter. As the fibre from a thalamic nerve cell enters the cortex, it breaks up into a great many branches, which are beaded. The beads, called boutons, are the points of connection between the nerve fibres and the cells in the cortex. The connection is made by a structure called a synapse, a specialisation of the membrane of the bouton that can only be seen using the very high magnifications of an electron microscope. The bouton itself contains many small packets of chemicals known as neurotransmitters, which are the means of communication between cells, as opposed to the electrical impulse that is the signal sent out from the nerve cell body down the nerve fibre. When this electrical signal arrives in a bouton, the neurotransmitter is released and crosses the synapse.

> **66**
>
> ***Each square millimetre of the cortex covers about 100,000 nerve cells. In primates, the visual cortex alone covers about 320 million nerve cells.***
>
> **99**

The nature of the neurotransmitter is critical in determining what happens next, because some neurotransmitters activate, or 'excite' their target cells to produce an electrical impulse, while other neurotransmitters act to prevent impulses being produced and so 'inhibit' their targets.

Extensive Branches

The nerve fibres from the thalamus excite their target cells. Our research has shown that the branches of these fibres is far more extensive than was supposed, and that as many as 5000 cells can be contacted by the branches of a single fibre from a thalamic cell. However, each fibre contributes no more than a few synapses to any single cell, whereas we know that each nerve cell in the cortex receives at least 3000 synapses.

The activity of each synapse produces only a small potential change in the cell to which it connects, and because each cell has a threshold to be reached before it produces an electrical impulse, the activity of hundreds of excitatory synapses has to be added together before the cell sends the electrical signal down its nerve fibre. This is a critical observation, for it gives us the first hint of how the cortex might be working.

The high degree of convergent excitation that is required to activate a single cell makes it very different from the computers with which we have been comparing it. Unlike the computer, which is organised in a very hierarchical way, the cortex seems to be operating as a democratic society. Only when enough cells agree that an event has taken place do they act together to produce an electrical impulse in the cells on which they converge. This circuitry is in sharp contrast to that found at earlier stages in the visual pathways, where the linkage between one nerve cell and the next is very much more secure because there is much less convergence and divergence.

These experiments indicate that the principle on which the cortex is designed is one where each nerve cell talks to many other nerve cells and, in turn, receives communication from a great many nerve cells. There are a number of good reasons why this should be so. One big problem that needs to be dealt with by the brain is that the transmission time along the nerve fibres and across the synaptic junctions is very slow. If these conduction times were transposed to a computer, the processing times just to read a single line of text would be intolerably long. The situation is made worse by the fact that most of the problems the cortex has to deal with are complex and, naturally, the time taken to arrive at a solution increases with the complexity of the problem. Yet we can arrive at solutions to complex tasks with remarkable speed.

Parallel Processing

The paradox of how rapid solutions are achieved using circuitry that operates ▶

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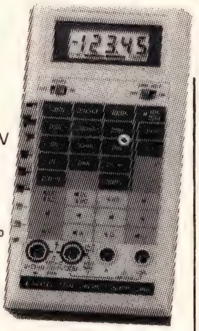

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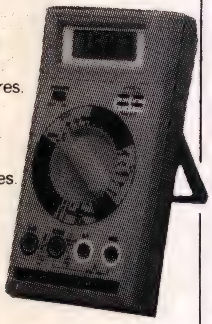

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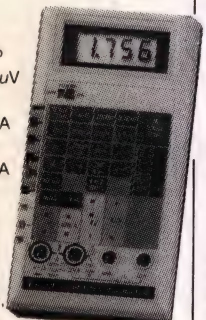

Vdc 0.2-1000V, 5 ranges 100uV max resolution, 0.5%

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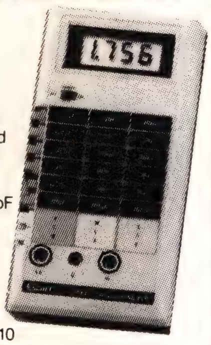

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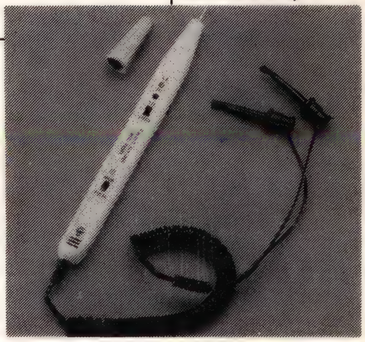

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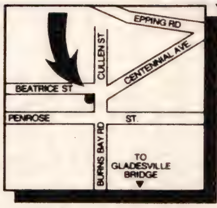

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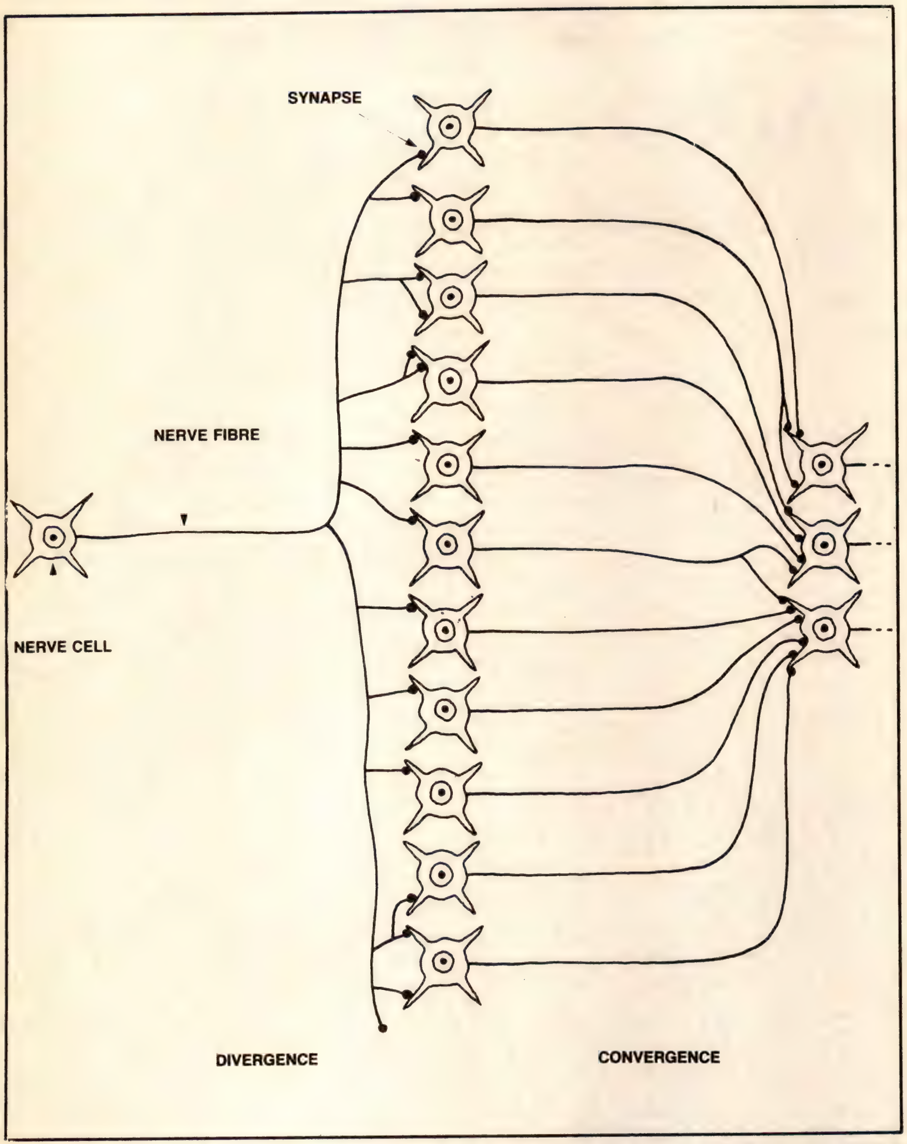

The cortex is built on the principles of divergence and convergence. One nerve cell diverges to contact many other cells and each cell in turn receives a convergent input from many other nerve cells.

slowly is explained by a technique known as parallel processing. This is a means of breaking up a single complex task into a number of sub-tasks than can then be solved simultaneously instead of sequentially. The result is that the overall processing time is reduced. It is the high degree of divergence in the input of single nerve cells to the cortex, and of nerve cells within the cortex itself, that provides the structural basis to make this parallel processing possible. In this way, the severe physiological limitations of the speed at which individual nerve cells can operate are offset by having a great many working at the same time on the same problem.

The converse aspect of the circuitry, a single nerve cell receiving a convergence input from many other nerve cells, also has important functional implications. Many nerve cells, particularly at the sensory surfaces such as the skin or retina, are spontaneously active. This could be a source of confusion if every nerve impulse arriving at the cortex was interpreted as an indication that something had been seen or felt. We would be living much of the time in a land of illusions. The design of the cortex ensures that this random activity is filtered out, because only the simultaneous action of hundreds of cells produces an electrical impulse in the cell or cells on which they all converge. Simultaneous activity in all these cells is most unlikely to occur through random spontaneous activity, so only real events produce the required simultaneous activation of large numbers of nerve cells.

However, even in normal vision the cortex has to create illusions in order to sidestep some of the inherent limitations of the system. For example, the visual field of each eye contains a blind spot that corresponds to the region of the retina where the optic nerve leaves the eye. We have no conscious awareness that there is any gap in our field of view, because the brain is able to fill gaps in our visual space. Similar filling-in can occur in time, too. This is well demonstrated by our experience of cinema films, where 24 'stills' are presented successively every second, yet our experience is of continuous, smooth motion. These illusions of continuity in our visual experience are clearly preferable to a disjointed and incomplete view of the world. A great deal of what the cortex as a whole does may be to provide the most complete view it can of the world around us. when not enough information is present, we make the best guess, which unfortunately (and sometimes embarrassingly) is not always the correct one.

Highly Ordered

A crucial factor in our interpretation of a visual scene is that the stimulation must be such that the cortical circuits are activated in a highly ordered way in space and time. when this essential requirement is not met, the brain cannot usefully interpret the input. A simple illustration of this is the common experience of 'seeing stars' after receiving a knock on the back of the head. The mechanical stimulation activates large numbers of cortical neurones directly and we have the experience of moving points of lights, called phosphenes. This experience does not correspond to any normal visual perception because the knock on the head does not activate the cortical circuits in the appropriate pattern.

It is only through a knowledge of the circuitry and function of the cortical modules that we will be able to understand the nature of the processing that the cortex is doing. At present we are still grappling with very basic aspects of this problem. Even when these are solved many big issues will remain, such as how our memories are used in cortical processing to solve problems of recognition, and how we are able to direct our attention to particular tasks and ignore extraneous distracting stimuli, and understanding why we are 'conscious'.

Solving these problems is till one of the most formidable tasks in biological research, but the rate of progress, and the development of new ways of unlocking the secrets of the cortical microchip, make this one of the most exciting and promising areas of new research. ●

** by Dr Kevan Martin, UK Medical Research Council Anatomical Neuropharmacology Unit, Department of Pharmacology, Oxford University*

CELLULAR RADIO

The term cellular radio implies amoebas with antennas. In fact the cellular radio system recently installed by Telecom introduces a new dimension to public communication.

Mervyn Beamish

The cellular radio concept of communication is almost a text book example of lateral thinking; it takes the negatives of a traditional two-way radio and turns them into positives. Two-way radio is plagued by the need for powerful transmitters, is heavy on frequency use, cumbersome with its single voice channel transmission and is susceptible to shadow areas of reception.

Cellular radio uses low power transmitters, is very frugal in its frequency usage, utilizes a duplex transmission system and, because of its geographical spread, shadow areas are reduced to a minimum.

With the launch of Telecom's MobileNet system in February this year, and the associated media coverage, any reader with the slightest interest in technology and communications would, by now, understand the concept of cellular radio.

The Basics

Basically the geographical area the system is to cover is divided into cells. Cell size and shape is determined by subscriber base and physical features that affect propogation. The MobileNet coverage map of Sydney (Fig. 1) is a good illustration of this. However, a theoretical grid pattern of hexagonal cells make the conept easier to visualise (Fig. 2).

Cellular radio utilizes FM transmission. One of the features of FM is a sharp cutoff at the edge of its reception range. Imagine each cell represents the effective range of its own small FM radio transceiver — which in fact it is. These transceivers are called base stations. Adjacent cells have their own base stations operating on different frequencies and, in turn, they act as buffers or absorbency zones between one cell and the next to utilize the same set of frequencies. A cellular car-phone, for example, moving between cells automatically utilizes a frequency of the cell it is currently occupying (Fig. 2). All this is controlled by a central switching computer.

Primarily the car-phone, when switched on but not in use, works on the same principle as the frequency scanner used by CB and amateur radio operators. It is constantly scanning the full range of frequencies used by the cellular network for the code number which will indicate that there is an incoming call. On receiving this code it will switch to the strongest frequency available and tell the central computer to channel the call via the base station of whichever cell the strongest frequency originates. The central computer then takes control, switching from cell to cell, as the car-phone moves around until the call is finished. A similar pattern of events occur for both outgoing and incoming calls

Cellnet

Cellular radio is not reliant on additional bandwidth to expand; let me rephrase that; it is not solely reliant on additional bandwidth for expansion. As a geographic area becomes overcrowded with subscribers the cells in that area are reduced in physical size and more cells added — basically the strength of the base station signal

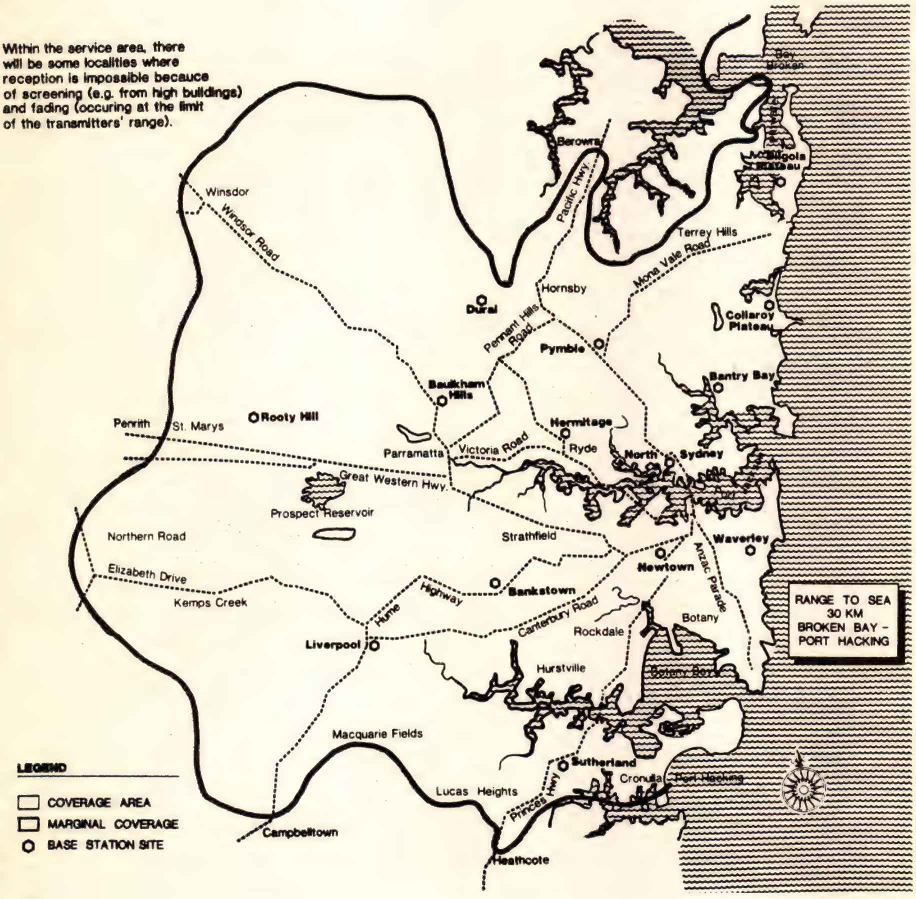
Within the service area, there will be some localities where reception is impossible becauce of screening (e.g. from high buildings) and fading (occuring at the limit of the transmitters' range).

Figure 1: Mobicenet map — Telecom can supply.

is reduced and new base stations are added. Hong Kong, at the present moment, holds the record for the smallest cell size which is 1.2 kilometres in radius.

Cellnet is one of the two cellular radio networks operating in Britain and is run by British Telecom and Securicor.

Over the 1986 June holiday weekend, Cellnet dramatically increased its subscriber capacity. This was achieved through cell sectoring. In a standard cell the base station transmits and receives omnidirectionally (360 degrees). By changing this pattern to 60 degrees a cell can be divided into six sectors. Each sector is allocated a different range of frequencies. The cellular pattern can then be rearranged so that no cell or sector utilizing the same frequencies touches. Cellnet's old 12 unit cell pattern reused a frequency every 13th cell, but by sectoring the cell pattern was reduced to four units and frequencies reused every 5th cell.

Cellnet's average cell is four kilometres across. However, by sectoring the four busiest base stations in London the actual cell size has been maintained but the capacity raised from 35,000 to 60,000 subscribers.

> “ ***it takes the negatives of a traditional two-way radio and turns them into positives*** ”

Problems arising from sectoring include increased demand on the switch capabilities of the central computer and interference from adjacent cells. Cellnet's sectorisation program is being observed by operators all over the world.

Digital Transmissions

Digital transmission is the area in which most research and development in cellular radio is being undertaken. Nearly all major manufacturers are involved in the search for cost effective digital hardware designs.

Telecom is confident that the MobileNet system will 'go digital' by late 1990.

The working of a cellular radio system is dependent upon its ability to transmit and receive combined voice and data signals. The current analog systems are limited in this facility. A digital system will dramatically increase the amount and accuracy of data sent and received through a cellular system.

Currently Telecom advises its customers that MobilNet is not 100% secure. A determined radio operator with a scanning device might be able to eavesdrop on telephone conversations from MobileNet. Digital transmission will allow encrypted voice signals and therefore increase message security.

The availability of additional data transmission capabilities, with digital technology, will lead to additional customer services such as notification of a third party calling, current call charge and even messages and images on a CRT display unit.

One other effect will be a significant reduction in the 'multipath effects'. Multipath effects arise because antenna on mobile and handheld units are almost always below the heights which permit direct line-of-sight propagation to and from a base station. The signal received contains a mixture of direct and indirect components. These components are the results of random diffraction and reflection of radio waves by buildings and other objects. Digital transmission techniques will be able to resolve indirect random elements causing this effect and produce a cleaner signal.

Digital techniques also require less power and therefore less bulk in handsets. Developments in this area combiend with reduced battery size will lead to miniaturisation of hardware. Miniaturisation similar to the famous Dick Tracy watch and communication devices that Startrek devotees associate with the words “Beam me up Scotty!”

Telecom in the 1990's

The magic number for MobileNet is 1990. By 1990 all capital cities and the majority of provincial towns throughout Australia will be linked into the Telecom cellular ▶

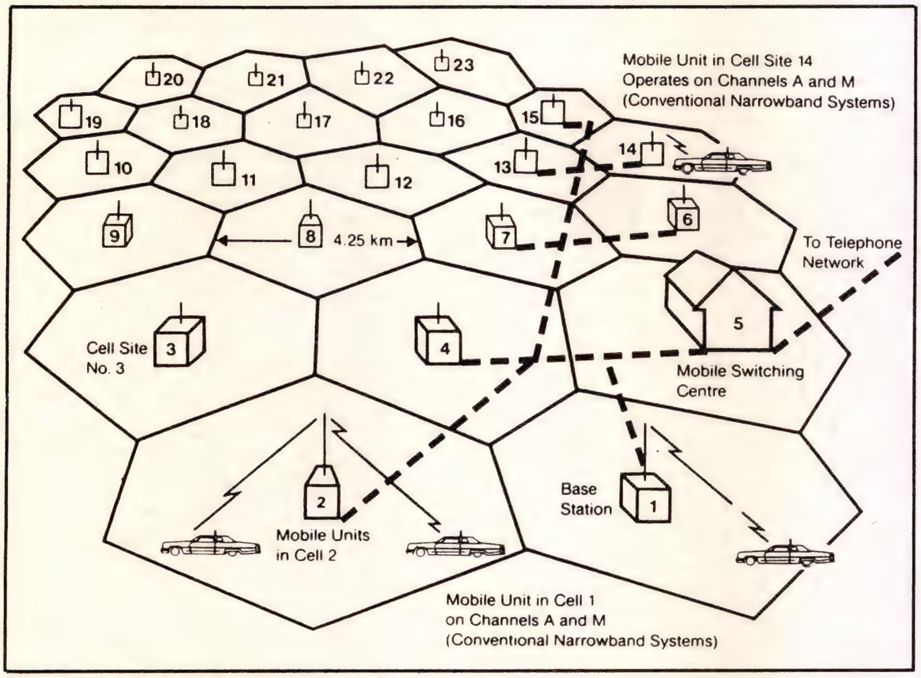

Figure 2: Cellular network grid.

radio system. Major highways will be part of the nationwide system and expansion into the less populated parts of the country will have commenced.

While Telecom is visualising and planning its future within limited public view the Department of Communications seem to be more restrictive with their information.It would seem that there is a passing mention of 'mobile coms.' being part of the services packages proposed for the new 'AUSSAT Birds' and that it is part of another Cabinet Submission. Whether 'mobile coms.' include an involvement with cellular radio was not known. Planned bandwidth allocation for the inevitable expansion of Cellular systems within the country also was not known.

"We tend to be a follower," the department spokesman said, ". . . Not that the intelectual thinking isn't being done but it is what the Minister will permit us to release."

To be fair the department offered me the use of their library and are following up some more definite replies to my questions but you would have thought with Cellular Radio being the 'flavour of the month' good Public Relations would have been better achieved with a short press release on the topic.

Satellite Communication

The Department of Communications passing comment about AUSSAT could be very significant to the future of Cellular radio in this country. Whilst-ever Telecom operates MobileNet within the populated coastal fringe of this country our cellular system can operate in traditional fashion. But what about the remote inland areas.

In November 1985, Salt Lake City (US), an inaugural trial of a system that combines the distinctly different technologies of Satellite and Cellular communications took place. The aim was to develop an 'immediate portable communications service'.

The three companies involved in the trial were NewVector Communications (cellular service provider), AT&T Network Systems (cellular switching service provider) and American Satellite (earth station provider).

The bi-product of this development which caught most media attention was then an American trucking company utilized the technology to communicate with and geographically pinpoint the location of each of its trucks. But the significance is much greater. The system was developed primarily as an immediate portable emergency communications service. However, commercially its impact has been to link rural and remote areas of the USA into a national cellular network.

"Generally speaking, the advantages of this type of wireless distribution of voice and data communications is dramatic in rural areas or in circumstances where communications are down due to a natural disaster," says Bill Scott, American Satellite's Director of Systems Development Engineering, "Now all that is needed in these situations is a cellular system, a satellite, and a combined portable each station and a cell site. The solution is quick, efficient and reliable."

The satellite links widely spread base stations (earth stations) with the central cellular switching computer and also acts as the channel for voice and data signals in and out of these remote areas. I presume that the satellite, under some circumstances, could also act as a base station.

This technique would also be able to link aircraft and ships into a cellular system.

Automated Mobile Office

It only takes an elementary knowledge of radio direction finding or navigation to realise a number of added benefits to the cellular system. The cellular system's central computer could plot the precise location of every operating subscriber transceiver.

Imagine a future Taxi service that was leased part of a city wide cellular system. The dispatcher on receiving a booking would key the location into a computer and immediately a street map would appear on the VDU. A series of flashing coloured icons would indicate cabs in the area. The icons would represent cabs that were engaged or not for hire, those with prior bookings who would be unable to take the job, those sitting on ranks or cruising looking for fares. A selection of the appropriate cab would be made by the computer based on any priority list, eg, cabs on ranks get first offer, traffic condition and time of pick-up. The dispatcher could override the decision as required. In the cab the driver would not only receive, via a dashboard communications module, the details of the pickup and route recommendation based on current traffic flows etc.

An added advantage would be security for the drivers. On an emergency signal from a driver the dispatcher, or police, would know exactly where the cab was and even be able to listen to the voices of its occupants.

This is not exactly fantasy — the technology is already here and working on similar systems to MobileNet. Racal Electronics are already talking with Telecom about the introduction of their Automated Mobile Office services. The services inlcude telecopying of documents (Fax), printing facilities, display of road, weather and traffic information maps, TV telephone and VIDEOTEX systems as well as Data Terminals with electronic mail, data base access and online computer accesss etc.

The mind boggles when trying to picture all this equipment on the dashboard of a car, but in the form of a small attache case it seems to become more imaginable. Racal are already transmitting and receiving various forms of data on the USA cellular systems and are only waiting for Telecom's green light to do the same here.

Possibilities of a Worldwide System

Great dreams of a worldwide cellular communications system are diluted by a traditional technological problem — incompatability.

The Australian MobileNet is using the AMPS system the same as USA, New Zealand, Canada, Phillipines, South Korea, Thailand and a number of other countries. There are at least four major systems and a number of minor ones each with their own incompatible interfaces.

The NMT system has been adopted by Britain, Uganda and China. China in actual fact has two systems. It also has the TACS system along with Spain, Greenland, Saudi Arabia, Malaysia, Indonesia and a number of Asian countries.

The Europeans have one of the longest running commercial systems which, I'm led to believe, does not incorporate the latest cellular technology. However, the EEC is working towards a pan-European system including Britain. This may well be the first significant clash of systems and a lot of interest will be focused on the European experience.

International travel and communication is as familiar as Vegemite to the Australian and Apple Pie to the American. One day all countries will agree on a common technology and the cellular radio system will cross all national frontiers. People will pack their cellular telephones along with the credit cards and passport.

Arther C. Clarke said "Man can suffer nostalgia for the future." and George Lucas has underlined this claim. Cellular Radio is the stuff that dreams of the future are made of — and what very feasible dreams they are too.

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CRISIS FACES SHORTWAVE BROADCASTERS

The World Administrative Radio Conference is faced with some big problems in trying to allocate frequencies to the plethora of competing broadcasters. All over the world nations are using more frequencies, more power and jamming each other in a bun fight to get messages out.

Arthur Cushen

Last January, a meeting of the World Administrative Radio Conference representatives was held in Geneva to discuss the future of shortwave broadcasting.

The main problem confronting them is that of too many stations for too few frequencies, and in an attempt to accommodate the international, regional and local broadcasters on the channels available a new approach has been made. Stations have been requested to indicate not only the time and frequency they require, but program details as well.

In 1984 representatives of the Post and Telegraph Administration met in Geneva to find a way of portioning out the shortwave frequencies. The result was that stations were required to advise Geneva of their needs for frequencies and details of areas of service. The requests were fed into an adjudicating computer which allocated one frequency per broadcast to one target area, although provision was made for a second if necessary. If a station encountered interference problems, it was up to it to sort them out.

In an attempt to find out the limitations of this system, operating stations were asked to submit requirements for December 1985 and June 1988. One hundred and three countries out of the 160 which comprise the WARC replied — and the full extent of the shortage of frequencies became clear. The band between three and 30 MHz held between 12,000 and 18,000 hours of program per day. And this was exacerbated by the low sunspot activity forcing congestion of stations on the lower bands.

The results showed that some 30,000 hours of daily program time is presently needed, rising to 39,000 hours by June 1988, based on an allocation of one program per frequency.

Radio Nederland's "Media Network" has reported Jim Vastenhoud, a member of the Dutch delegation, as saying that at the present time less than half of the requirements can be fitted into the available frequencies and, in fact, only 43 per cent of stations operating could be allocated frequencies relatively free from interference.

At present there are some 2200 shortwave transmitters on air of which more than 300 are 500 kW strength, and some 900 are 100-300 kW. It is expected that if any new plan comes into operation it would require the larger international broadcasters to cut back on their transmitters. For example, Radio Nederland with eight transmitters would be able to operate 78 per cent of its schedule under the new plan, with a corre-

VOICE OF HOPE

The Voice of Hope, KVOH, at Los Angeles has been testing with a 50 kW transmitter on an initial frequency of 17775 kHz. The station is associated with the "King of Hope" in Lebanon, which has been in operation for some years and in recent weeks has been using 6280 kHz.

The transmitter used by the Voice of Hope was originally owned by HCJB, Quito, Ecuador. High Adventure Ministries, the operator of the Voice of Hope, purchased this RCA 100 kW transmitter and it was shipped from Ecuador in two containers through the port of Guayaquil to Los Angeles.

The new transmitter has been installed in a building on top of a hill in Simi Valley. The transmitter, rated at 100 kW, is expected to be only used at 50 kW.

The present schedule is: 1400-1600 UTC on 9852.5 kHz, 1600-2200 UTC on 17775 kHz; 2200-2400 UTC on 15120 kHz; 0000-0300 UTC on 11930 kHz; 0300-0600 UTC on 9852.5 kHz; 0600-0800 UTC on 6005 kHz. According to announcements, reception reports are appreciated and should be sent to KVOH, PO Box 93937, Los Angeles, California 90093.

— Arthur Cushen

sponding reduction of 22 per cent in daily transmissions. And all transmissions carried on more than one frequency would have to be cut back to a single channel. This would affect Australian listeners, for instance, as Radio Nederland's service through Bonaire 0730-0825 UTC is carried on 9630 and 9715 kHz; only one of these channels would be permitted to carry the Radio Nederland transmission.

Jamming

Broadcasters from Western Europe carrying transmissions for instance in Russian use a multitude of frequencies in order to beat the jamming. In future one channel only would be allocated. In theory this would reduce the amount of jamming on the bands, as the USSR would concentrate on the single channel carrying the Russian broadcast. A decrease in jamming may in some way overcome the frequency problems as more channels free from interference would become available.

The main country which would have to reduce frequencies would be the USSR. We note, for instance, at 0700 UTC Radio Moscow World Service is receivable on 42 channels. These are beamed to Europe, Africa, Asia and the Far East. In theory these frequencies would be cut to one for each area which would mean at least the silencing of 30 transmitters.

The introduction of such a plan should cause concern to radio listeners, particularly the casual listener, as each of the four seasons of the year a different frequency plan will be in use. No longer will the casual listener be able to say that he finds Radio Australia on a certain spot on the dial, as Melbourne will not have any 'right' to a frequency, but can be allocated any frequency which it is felt would be efficient enough to serve the target area.

As the WARC sees it the way for shortwave broadcasting to combat this present problem is by the introduction of single side band transmissions, and already some international stations are testing with that type of transmission. An improvement in receiver selectivity will be essential in order to tune into an SSB transmission and receive a strong clear stable signal. The introduction of SSB transmissions is faced with problems: some countries do not wish to move to SSB, and naturally the receiver manufacturers will not put on the market equipment capable of SSB reception, unless there is a large audience wishing to buy this improved type of radio receiver.

The whole matter of the better utilization of shortwave frequencies is at the crossroads and it is felt that many governments will not be prepared to cut their international broadcasting by half in an attempt to try and get a clearer signal for the shortwave listener. Continuing chaos on the bands could well be with us yet in the years to come. ●

COMPROMISE FOR SWISS TRANSMITTER SITE

Local inhabitants have agreed to a compromise settling a dispute over the site of a new high powered shortwave facility in Switzerland.

The compromise involves feeding the hot water from the transmitter's cooling system into the village free and the installation of a community cable radio and television system (free again) to overcome possible interference from the nearby transmitters.

Since 1939, Swiss Radio International's main transmitting site has been located at Schwarzenburg, about 16 km from Berne, and until the late 1960s these facilities were found adequate. However, with an increasing number of shortwave stations around the world there followed an increase in facilities and power in a bid to provide better reception. Local opposition in Schwarzenburg blocked the Swiss PTT (Post Telegraph and Telephone) plans for expansion of the station there, so a new site had to be found.

It was planned that the new facility would have bigger antennas with masts 50 to 120 metres tall between which there would be strung massive aerial systems. The site would have to be away from high hills and mountains and the ground should have good conductivity, ie, wet land would be ideal. After an evaluation of 20 sites the choice was narrowed to area in the western Canton of Berne.

The project faced local opposition for its effect on the environment and the possibility of electrical interference. There was also the fear that electrical fields produced by the transmitters might damage health.

It has been felt in the past that the Swiss PTT has been at fault in not following up complaints from the Schwarzenburg area, but apparently it has learnt its lesson and has agreed to assist with the problems faced by the new transmitting site inhabitants.

— Arthur Cushen

KILOHERTZ COMMENT

DUBAI: United Arab Emirates, Dubai is using 9595 kHz for its English broadcast 0330-0400 UTC. This transmission is also available on 11940 kHz, and as well as news and commentary, there is a daily feature on life in the Arabian Peninsula. On Sundays the Mailbag session answers questions about the United Arab Emirates.

GABON: Swiss Radio International for the first time, is leasing time on an overseas relay station and is using the facilities of Africa Number One, at Moyabi, Gabon to broadcast to South America. Using 9625 kHz the transmission is 2215-0100 UTC. It is carried over a 500 kW transmitter, which is operated by a commercial organization in this West African country.

GUAM: KTWR, Agana, Guam has made a frequency change to 15115 kHz for its broadcast to New Zealand, which is heard daily. On Saturday "Distant Listeners' Log", is heard at 0830 UTC and the full English transmission is 0740-0900 UTC, with an earlier sign-on Friday and Saturday at 0730 UTC and on Sunday at 0715 UTC. A session in which letters are answered is featured on Friday at 0730 UTC. As well as English, KTWR which is operated by Trans World Radio, broadcasts in 10 Asian languages.

Adventist World Radio, KSDA, has been delayed in its broadcasting plans, but is expected to be operating this month with 100 kW and one antenna system. The tentative schedule is English 2100-2200 UTC on 7160 kHz, 0000-0100 UTC on 15300 kHz; 0200-0300 UTC on 17855 kHz. Other broadcasts will be in 14 Asian languages. According to a letter from the station, reception reports on initial test broadcasts are appreciated, and should be sent to AWR Asia, PO Box 7500, Agat, Guam 96928.

JAPAN: Radio Japan is using the transmitters of Radio Canada International at Sackville for two broadcasts in English and Japanese to North America. The broadcast has been retimed with English 1130 UTC and Japanese 1200 UTC on 6120 kHz. Radio Japan confirms reception of this relay broadcast through Sackville with a special verification card showing the satellite link to North America. Radio Japan's service to Australia continues to be very well received on its two frequencies, 11875 kHz and 15235 kHz 0900-1000 UTC.

USA: World Harvest Radio Station, WHRI, has been operating for one year with its Gospel programs and is heard on many frequencies. The most interesting reception has been 2100-2300 UTC on 9770 kHz, 0600-0800 UTC on 6100 kHz and 0800-1100 UTC on 7355 kHz. Reports are requested to PO Box 12, South Bend, Indiana.

The latest newcomer to operate from the United States is the project of Christian Science Monitor. Broadcasts are from WCSN, Scotts Corner, Maine and the present schedule to Europe is: 2000-2200 UTC, 7365 kHz; 0100-0200 UTC, 7365 kHz; 0200-0300 UTC, 9745 kHz; 0700-0900 UTC, 7365 kHz. There are also programs beamed to west, east and South Africa, according to the WRH newsletter.

This item was contributed by Arthur Cushen, 212 Earn St, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times quoted are UTC (GMT) which is 10 hours behind Australian Eastern Standard Time, and areas observing daylight time, should add an hour.

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TYPE UPS ....

The Ferguson UPS operating principle provides one of the very truly uninterruptible power supply systems and is designed for use with all well-known designs of micros, minis, communication, process control, CNC equipped machinery and security systems — indeed with all applications requiring reliable and pure electrical energy. The Ferguson UPS features a unique ferro-resonant Constant Voltage Transformer isolated supply, guaranteeing trouble-free "clean" power from the mains under normal conditions. Voltage fluctuations, spikes and other transient conditions are not only prevented from entering your apparatus but are also prevented from entering the UPS electronics, thus providing unique self-protection. When mains voltage or frequency falls below levels unable to be corrected by the Constant Voltage Transformer then the mains Synchronized inverter takes over to maintain continuous, clean, electrical energy for your vital electronic apparatus.

Advantages of a UPS System incorporating a Ferro-resonant Transformer

- Provides a sine wave of low distortion, typically less than 5%
- Attenuates transient common mode and transverse mode noise voltages.
- Maintains a constant output voltage over a wide mains input range.
- provides overload protection, being able to tolerate an indefinite short circuit.
- The ferro-resonant transformer stores energy in its 'tank circuit' which assists in a smooth changeover from mains to battery.
- No transient radiation from inverter circuitry.

Principle of Operation

The Ferguson UPS has four main components:

1. Constant Voltage Transformer
2. Battery Charger
3. Sealed Lead-Acid Battery Pack
4. Synchronized Inverter

Power enters the UPS via the input terminals of the Constant Voltage Transformer. The "clean" output from the CVT is then fed directly to the connected load (normal operation) and also to the Battery Charger. The Battery Charger is set to maintain the Sealed Lead-Acid Batteries in good operating condition ready for a voltage/frequency failure. The Inverter Control Circuits continuously monitor Inverter Synchronization with Mains Voltage in addition to monitoring Mains Voltage Level, Mains Frequency, Battery Volts and Battery Charger Output.

The output voltage of the UPS is regulated by the action of the CVT. When the mains voltage drops below 85% an electronic switch operates to disconnect the mains. The mains will be automatically reconnected when the voltage returns to normal.

In the event of an accidental short circuit on the output of the UPS no damage can occur. The Ferguson UPS and its electronic circuitry are fully protected against secondary short circuits and voltage transients.

Technical Data

Type Number	**UPS 250/15**	**UPS 750/15**	**UPS 1000/15**
Rating	**250VA**	**750VA**	**1000VA**

ELECTRICAL SPECIFICATIONS

Input Voltage	240VAC (+ or − 15%)	240VC (+ or − 15%)	240VAC (+ or − 15%)
Input Frequency	50Hz (+ or − 3%)	50Hz (+ or − 3%)	50Hz (+ or − 3%)
Battery Charging	Constant voltage with current limit (Float charging)	Constant voltage with current limit (Float charging)	Constant voltage with current limit (Float charging)
Output Rating	250VA	750VA	1000VA
Output Power Factor	0.8 leading to 0.8 lagging	0.8 leading to 0.8 lagging	0.8 leading to 0.8 lagging
Output Voltage	240VAC 50Hz	240VAC 50Hz	240VAC 50Hz
Output Regulation	(+ or − 4%)	(+ or − 4%)	(+ or − 4%)
Common Mode Rejection	>120dB up to 1MHz	>120dB up to 1MHz	>120dB up to 1MHz
Transverse Mode Rejection	>60dB 10KHz to 1MHz	>60dB 10KHz to 1MHz	>60dB 10KHz to 1MHz
Total Harmonic Distortion	Less than 5% (at 100% linear load)	Less than 5% (at 100% linear load)	Less than 5% (at 100% linear load)
Short Circuit	Self protected	Self protected	Self protected
Transfer Time	Less than 10ms	Less than 10ms	Less than 10ms
Backup Time	15 minutes	15 minutes	15 minutes
Additional Backup (Not provided with standard units)	Approx. 15 min for every additional 10Ah. capacity	Approx. 15 min for every additional 10Ah. capacity	Approx. 15 min for every additional 10Ah. capacity

DIMENSIONS (mm)

	170 x 440 x 350	340 x 440 x 350	340 x 440 x 350

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Letters to the Editor

A WARNING FOR LOUIS

WHILE I AM a comparitive newcomer to your ETI Journal I would like to compliment you and your technical writers for producing a well balanced coverage of electronic oriented articles and projects which I always find to be of great interest.

As a retired Broadcast Design, Planning, Construction and Installation Engineer of Radio Studios, I have found your articles on Audio subjects most interesting and it has helped me keep abreast of new techniques in audio amplifiers and reproducers.

I found the Louis Challis article 'Gallon Performance in a Pint Pot' quite interesting as during my professional career I had closely followed the development of better reproducer design resulting in a considerable reduction in the enclosure capacity without serious degradation of response at high power levels.

With regard to Louis Challis' section on Subjective Testing however it does concern me that there was no warning paragraph prefacing these details indicating that sustained monitoring of high levels in excess of 95 dB can be capable of causing irreparable damage to the ears. I do strongly believe that this fact should be always included in such articles to discourage readers from emulating the tests Mr Challis carried out. In particular the test in excess of 110 dB which as Mr Challis remarked "did not destroy the reproducers" but I do have some concern for the resulting effect on his hearing.

I have no doubt you would be aware that music conductors and recording studio engineers who are subjected to excessively high S.P.L.s (Sound Pressure Levels) for sustained periods ultimately suffer some form of hearing impediment.

I trust that you will accept my comments as constructive criticism as I believe there is a trend towards the need to monitor programme material at S.P.L.'s greater than 95 dB without appreciating the long term affects on the human ear, in a domestic situation.

J. E. Burgesson,
Cheltenham, Vic.

CONGRATULATIONS MATHEW

MAY I CONGRATULATE Mathew Sorrell of Clarence Park S.A. on his skill and knowledge at 10 years of age demonstrated by his completion of the projects referred to on page 44 of the cookbook.

Schoolboys over 60 years ago possessed similar skills and knowledge, limited of course by the range of components available to them. However varicaps, spider-web coils, crystal detectors, hand wound coils, Reinarts circuits and the many advances in technology were just as challenging to them as the ICs etc are to the boys of today.

I do not intend to make up Mathew's project because I merely have to walk into the garden to hear the natural sound of a buzzing mosquito.

W. C. Harris,
Windsor, Qld.

```
 9 REM **TITLE SCREEN**
 10 PRINT"{CLR}":SS=53280:SC=0:HS=00:V=53248
 20 POKESS.0:POKESS+1.0
 30 PRINTTAB(15)"{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{RED}{RVON}              {WHT}
 35 RESTORE
 40 PRINTTAB(15)"{WHT}{RVON}LONG JUMP."
 50 PRINTTAB(15)"{RED}{RVON}          "
 60 PRINTTAB(14)"{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{WHT}{RVON}PRESS A KEY!{RVOF}"
 70 A$="BY JOHN AVIS":D$="{HOME}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN
X{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/RT}{C/RT}{C/RT}{
C/RT}{C/RT}{C/RT}{C/RT}{C/RT}{C/RT}{C/RT}{C/RT}{C/RT}{C/RT}"
 80 B$=CHR$(29):C$=B$+B$+B$+B$
 90 A$=C$+C$+C$+C$+A$+"  ":FORA=1TOLEN(A$)
 100 PRINTD$:MID$(A$.A.12):CHR$(145)
 105 GETE$:IFE$<>""THEN120
 110 FORX=0TO80:NEXTX.A:GOTO70
 119 REM **SPRITE INIT.**
 120 PRINT"{CLR}":POKESS.5:POKESS+1.13
 130 V=53248:POKEV+21.1:POKE2040.192
 160 FORN=0TO62:READQ:POKE12288+N.Q:NEXT
 162 POKEV+23.1:POKEV+29.1
 165 POKEV+39.0
 169 REM **SCREEN DISPLAY**
 170 PRINTTAB(25)"{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}{
C/DN}{YELO}{RVON}                 "
 180 PRINT"{RVON}{LRED}                              {C/RT}{C/RT}{YELO}             "
 190 PRINT"{RVON}{LRED}                             {C/RT}{C/RT}{YELO}              "
 200 PRINT"{RVON}{LRED}                            {C/RT}{C/RT}{YELO}               "
 210 PRINT"{RVON}{LRED}                           {C/RT}{C/RT}{YELO}                "
 220 PRINT"{RVON}{LRED}                          {C/RT}{C/RT}{YELO}                 "
 230 PRINTTAB(19)"{RVON}{YELO}                       {RVOF}"
 239 REM **SPRITE CONTROL**
 240 SP=20:X1=19:Y1=147:X2=172:Y2=66
 250 JS=PEEK(56320)
 260 IFJS=119THENSP=SP-1
 270 IFJS=123THENSP=SP+1
 280 IFJS=111THEN500
 290 IFSP>20THENSP=20
 300 IFSP<1THENSP=1
 310 IFX1>160THENPRINT"{HOME}{BLK}FAULT":FORTE=0TO2000:NEXT:PRINT"{CLR}":POKEV+
.0:GOTO20                                                                    21
 320 X1=X1+2
 330 POKEV.X1:POKEV+1.Y1
 340 FORTL=1TOSP:NEXT:GOTO250
 499 REM **GAUGE DISPLAY**
 500 GA=1
 510 PRINT"{BLK}"
 520 JJ=PEEK(56320):IFJJ=110THENGA=GA+1
 530 IFJJ=109THENGA=GA-1
 540 IFGA>3THENGA=3
 550 IFGA<1THENGA=1
 560 IFJJ=127THEN600
 570 IFGA=1THENDR$="00 DEGREES":PRINT"{HOME}":DR$
 580 IFGA=2THENDR$="45 DEGREES":PRINT"{HOME}":DR$
 590 IFGA=3THENDR$="90 DEGREES":PRINT"{HOME}":DR$
 595 GOTO520
 599 REM **JUMP ROUTINE**
 600 IFGA=1THENDE=71
 610 IFGA=2THENDE=97
 620 IFGA=3THENDE=84
 630 JD=DE-(2*SP)
 640 HJ=JD/2:X3=X1+HJ
 650 POKEV.X3:POKEV+1.140
 660 FORTM=0TO500:NEXT
 670 POKEV.X3+HJ:POKEV+1.147
 680 JL=INT(JD/12):FORTM=0TO2000:NEXT:GOTO1000
 999 REM **SCORE SCREEN**
 1000 PRINT"{CLR}":POKESS.0:POKESS+1.0
 1010 PRINT"{WHT}{C/DN}{C/DN}{C/DN}{C/DN}{C/DN}YOU JUMPED ":JL:" METRES"
 1020 IFJL>7THENG$="EXCELENT":GOTO1060
 1030 IFJL>5THENG$="WELL DONE":GOTO1060
 1040 IFJL>3THENG$="OK":GOTO1060
 1050 IFJL<3THENG$="PRACTICE NEEDED"
 1060 PRINT"{C/DN}{C/DN}{C/DN}{RVON}":G$:"{RVOF}"
 1070 FORTM=0TO2000:NEXT:PRINT"{CLR}":POKEV+21.0:GOTO30
 2000 REM **MAN DATA**
 2010 DATA0.0,0,0,248,0.1,16.0.1,48.0,1.8.0,0.144.0.0.96.0,0.144.0,1,104.0,3.104
 2020 DATA0,7,104.0,13,126.0,9,126.0,13.8.0.4.200.0.1,168,0,1.168.0.7,164,0,7
 2030 DATA148,0,6.30.0,6.30.0

READY.
```

Long jump

The object in this game of strategy is to find the best combination of speed and angle to jump the furthest. The controls are: joystick left — slow down; joystick right — speed up; fire button — start jump; fire button and up — degrees up; fire button and down — degrees down; releasing the joystick starts the jump.

John Avis,
Frenchs Forest, NSW

```
00010 REM     Scientific Calculator
00020 REM    S.L. Robjohns  May 1985
00030 CLEAR:SD10:DIM RO(10)
00040 J=1:HIRES:PLOT 252,0 TO 252,255:PLOT 248,0 TO 248,255:PLOT 30,0 TO 30,255
00050 F0=0:F1=0:F2=0:KO$="]":N=1:NO=0:N1=0:Y=0:BO=57.2957795: ON ERROR GOTO 1040
00060 GOSUB 860:GOSUB 70:F0=1:GOTO 280
00070 N2$="":I=7:CURS2,J:PRINT KO$:CURS6,J:PRINT" ";
00080 KO$=KEY$:IF KO$="" THEN 80 ELSE GOSUB 1080
00090 IF KO$="K" THEN GOSUB 680:CURSI,J+Y:PRINT" ";:GOTO 80
00100 IF KO$="P" THEN LET N2$=STR(3.1415926):CURS6,J:PRINT N2$:Y=1:GOTO 80
00110 IF KO$="B" THEN LET N2$=STR(BO):CURS6,J:PRINT N2$:Y=1:GOTO 80
00120 IF KO$="<" THEN GOSUB 990:N2$=STR(RO(W)):CURS6,J:PRINT N2$:Y=1:GOTO 80
00130 Y=0:IF KO$="D" THEN GOSUB 920:N2$="":CURSI-1,J:PRINT" ";:GOTO 80
00140 IF KO$="E" THEN CURSI,J: PRINT"E";:I=I+1:F1=1:M1=VAL(N2$);N2$=""  ELSE 190
00150 SO$=KEY$:IF SO$="" THEN 150
00160 IF SO$="+" THEN LET S1=1:GOTO 180
00170 IF SO$="-" THEN LET S1=-1:GOTO 180 ELSE CURSI,J:PRINT"?";:GOTO 150
00180 CURSI,J:PRINT SO$:I=I+1:CURSI,J:PRINT" ";:GOTO 80
00190 IF KO$<"0" AND KO$<>"." OR KO$>"9" THEN 210
00200 N2$=N2$+KO$:CURSI,J:PRINT KO$;:I=I+1:GOTO 80
00210 IF F1=1 THEN LET F1=0:M2=VAL(N2$):NO=M1*10^(S1*M2):GOTO 230
00220 NO=VAL(N2$)
00230 IF F0=0 THEN LET N1=NO
00240 J=J+1:RETURN
00250 KO$=KEY$:IF KO$="" THEN 250 ELSE GOSUB 1080
00260 IF KO$="K" THEN GOSUB 680:CURS1,J+1:PRINT" ";:GOTO 250
00270 J=J+1:GOSUB 1000
00280 IF KO$="+" THEN GOSUB 70:N1=N1+NO:N=N+1:GOSUB 1000:GOTO 280
00290 IF KO$="-" THEN GOSUB 70:N1=N1-NO:GOSUB 1000:GOTO 280
00300 IF KO$="*" THEN GOSUB 70:N1=N1*NO:GOSUB 1000:GOTO 280
00310 IF KO$="/" THEN GOSUB 70:N1=N1/NO:GOSUB 1000:GOTO 280
00320 IF KO$="=" THEN 670
00330 IF KO$="Q" THEN LET N1=N1*N1:GOTO 670
00340 IF KO$="A" THEN LET N1=-N1:GOTO 670
00350 IF KO$="M" THEN LET N1=N1/FLT(N):GOTO 670
00360 IF KO$="S" THEN LET N1=SIN(N1/BO):GOTO 670
00370 IF KO$="C" THEN LET N1=COS(N1/BO):GOTO 670
00380 IF KO$="X" THEN LET N1=EXP(N1):GOTO 670
00390 IF KO$="Y" THEN LET N1=10^N1:GOTO 670
00400 IF KO$="I" THEN LET N1=1/N1:GOTO 670
00410 IF KO$=">" THEN GOSUB 930:GOSUB 850:CURS1,J+1:PRINT" ";:GOTO 250
00420 IF KO$="N" THEN LET F2=1:J=J+1:GOSUB 1000:GOTO 50
00430 IF KO$="@" THEN 30
00440 IF KO$="Z" THEN 660
00450 IF KO$<>"F" THEN 480 ELSE IF N1<0 OR N1>48 OR N1-FLT(INT(N1))<>0 THEN 1070
00460 IF N1=0 OR N1=1 THEN LET N1=1:GOTO 670
00470 T1=N1:FOR Z1=1 TO N1-1:T1=T1*(N1-Z1):NEXT Z1:N1=T1:GOTO 670
00480 IF KO$<>"H" THEN 510 ELSE IF ABS(N1)>1 THEN 1070
00490 IF ABS(N1)=1 THEN LET N1=N1*90:GOTO 670
00500 N1=N1/SQR(1-N1*N1):GOTO 660
00510 IF KO$<>"W" THEN 560 ELSE IF ABS(N1)>1 THEN 1070
00520 IF ABS(N1)=1 OR ABS(N1)=0 THEN LET N1=90-N1*90:GOTO 670
00530 N5=SQR(1-N1*N1)/N1:IF N1>0 THEN LET N1=N5:GOTO 660
00540 IF ABS(N5)<.01 THEN LET N1=N5*BO ELSE LET N1=ATAN(N5)*BO
00550 N1=180+N1:GOTO 670
00560 IF KO$<>"R" THEN 580
00570 IF N1>=0 THEN LET N1=SQR(N1):GOTO 670 ELSE 1070
00580 IF KO$<>"^" THEN 600 ELSE GOSUB 70
00590 IF N1>0 THEN LET N1=N1^NO:GOSUB 1000:GOTO 280 ELSE 1070
00600 IF KO$<>"T" THEN 620 ELSE LET N6=SIN(N1/BO):N7=COS(N1/BO)
00610 IF ABS(N6)=1 THEN 1070 ELSE LET N1=N6/N7:GOTO 670
00620 IF KO$<>"L" THEN 640
00630 IF N1>0 THEN LET N1=2.3025851*LOG(N1):GOTO 670 ELSE 1070
00640 IF KO$<>"G" THEN CURS2,J:PRINT"?":J=J-1:GOTO 250
00650 IF N1>0 THEN LET N1=LOG(N1):GOTO 670 ELSE 1070
00660 IF ABS(N1)<.01 THEN LET N1=N1*BO ELSE LET N1=ATAN(N1)*BO
00670 CURS2,J:PRINT KO$:CURS6,J:PRINT N1:GOTO 250
00680 CURS33,1:PRINT" +  add            -  subtract   "
00690 CURS33,2:PRINT" *  multiply       /  divide     "
00700 CURS33,3:PRINT" M  mean           =  terminator "
00710 CURS33,4:PRINT" ^  power          F  factorial  "
00720 CURS33,5:PRINT" L  log[e]         X  antilog[e] "
00730 CURS33,6:PRINT" G  log[10]        Y  antilog[10]"
00740 CURS33,7:PRINT" S  sin(x)         H  arc sin(x) "
00750 CURS33,8:PRINT" C  cos(x)         W  arc cos(x) "
00760 CURS33,9:PRINT" T  tan(x)         Z  arc tan(x) "
00770 CURS33,10:PRINT" Q  square         R  sq. root   "
00780 CURS33,11:PRINT" I  inverse        A  alter sign "
00790 CURS33,12:PRINT" P  3.14159        B  57.29578   "
00800 CURS33,13:PRINT" >  to reg.        <  from reg.  "
00810 CURS33,14:PRINT" D  delete         E  sci format "
00820 CURS33,15:PRINT" N  new calc       @  reset reg. ";
00830 CURS33,16:PRINT" [ Press any key to continue ]";
00840 IF KEY$="" THEN 840 ELSE LET U=0:V=0
00850 FOR Z=1+U TO 16-V: CURS33,Z:PRINT [A31 32];:NEXT Z
00860 CURS34: PRINT"Register":CURS50: PRINT"Contents": IF KO$=">" THEN LET J=J-1
00870 Q=1:FOR Z=100 TO 548 STEP 64:CURSZ:PRINT Q
00880 CURSZ+17-LEN(STR(RO(Q)))/2:PRINT RO(Q):Q=Q+1:NEXT Z:IF U=1 THEN 910
00890 CURS608:PRINT [A31 45]
00900 CURS740: PRINT"Press 'K' to receive": CURS804: PRINT"a list of key codes."
00910 RETURN
00920 I=7:F1=0:CURS5,J:PRINT [A27 32]:RETURN
00930 WO$=KEY$:IF WO$="" THEN 930      :REM  Register Storage
00940 IF WO$="+" THEN GOSUB 990:RO(W)=RO(W)+N1:RETURN
00950 IF WO$="-" THEN GOSUB 990:RO(W)=RO(W)-N1:RETURN
00960 IF WO$="*" THEN GOSUB 990:RO(W)=RO(W)*N1:RETURN
00970 IF WO$="/" THEN GOSUB 990:RO(W)=RO(W)/N1:RETURN
00980 W=INT(VAL(WO$)):RO(W)=N1:U=1:V=7:RETURN
00990 WO$=KEY$:IF WO$="" THEN 990 ELSE LET W=INT(VAL(WO$)):U=1:V=7:RETURN
01000 IF J<15 THEN 1030      :REM  Page Length Check
01010 FOR Z=1 TO 15:CURS5,Z:PRINT [A27 32]:CURS2,Z:PRINT" ":NEXT Z
01020 CURS6,1:PRINT N1:IF F2=1 THEN LET F2=0:J=3 ELSE LET J=2
01030 RETURN
01040 IF ERROR C<>26 THEN 1060 ELSE GOSUB 1010      :REM  Error Traps
01050 J=5:CURS2,1:PRINT"0":CURS10,3:PRINT"Division by Zero":GOTO 50
01060 GOSUB 1010:CURS8,3:PRINT"Error";ERROR C;" in Line";ERROR L:END
01070 GOSUB 1010:J=5:CURS2,1:PRINT KO$:CURS10,3:PRINT"Illegal Operation":GOTO 50
01080 H=ASC(KO$):IF H>96 AND H<123 THEN LET KO$=CHR(H-32):RETURN ELSE RETURN
```

Scientific calculator

The following program is written in MicroWorld BASIC for the Microbee PC. It allows the computer to be used as a scientific calculator without the inconvenience and inefficiency associated with undertaking arithmetical computations in the normal immediate mode. The program utilizes most of the common mathematical operations including standard arithmetic and power operations, trigonometric and logarithmic functions, factorial, inverse, change sign, square and square root plus data storage facilities.

The order of operation is (1) entry of a value; then (2) entry of an operator. The RETURN key is not required after entry.

(1) Values can be entered on one of the following ways:

- (i) in standard floating point format;
- (ii) in scientific format; the mantissa is entered, then *E* is entered followed by the sign of the exponent (+ or −), then the exponent, eg, 2.36E+9;
- (iii) by entering either *P* or *B* which corresponds to PI=3.14159 ... and the value 57.29578 ... used when converting from radians to degrees and vice versa; (1 rad × 57.29578 ... deg);
- (iv) by retrieving a stored value; this is done by entering < followed by a number *1* to *8* corresponding to the register in which the value is stored.

(2) Operators are entered by keying, immediately after the value, the letter or symbol corresponding to the operation required.

Operator	Result
+,−,*,/	Standard arithmetic operators. all can be used sequentially.
	Entered after the base and is followed by a value representing the power to give y^x. Note, if used in a chain calculation the base will automatically be the total to that point.
=	Need only be entered to terminate a series of the above operators when the final total is required. This total can continue to be operated on by keying in another symbol.
M	Entered at the end of a series of additions to give the mean. It can be entered in place of = or after = if the sum of the values is also required.
F	Calculates the factorial of the value.
I	Calculates the inverse (reciprocal) of the value.
A	To alter the sign of the value.
Q,R	Calculates the square and square root respectively of the value.
L,G	Calculates the natural and common logarithm respectively of the value.
X,Y	Calculates the natural antilog (e^x) and common antilog (10^x) respectively of the value.
S,C,T	Calculates the sine, cosine and tangent respectively of the value. Note, the initial value must be in degrees — use B to convert from radians.
H,W,Z	Calulates the arc sine, arc cosine and arc tangent respectively of the value. The result is in degrees.
>	Followed by a register number (1 to 8) to store the current value in that register, eg, 7 or followed by an arithmetic operator then a register number for arithmetic storage,

eg, >*7 (this will multiply the contents of register 7 by the current screen value and store the result in register 7).

D	Entered immediately after any value has been entered to delete that value — see part (1).
N	To end a series of calculations ready for a new set. Register values remain unchange d.
@	To clear the working area and reset all registers.
K	Entered at any time during calculations to obtaina listing of the key codes.

If an illegal operator is ent-red, ? will be displayed nd the Microbee will wait r a correct entry.

When an operator is ent-red, it will act on the current calculated total to that point nd not the last value ent-red, eg, keying 45T + 7.2 − .6L equals 1n(4.6). During chain calculations the cur-nt total may not be dis-played on the screen, de-pending on whether = was ntered. The running total is, owever, always being moni-red internally. Using this ode of operations in con-unction with ther arithmetic torage and recall facilities, chain calculations can be ccomplished quickly and fficiently.

Error messages will dis-layed if an attempt is made undertake any of the fol-owing improper operations:

division by 0
square root(x) where $x<0$
log(x) and x^y where $x<=0$
tan(x) where cos(x) is 0
arc sin(x) and arc cos(x) where abs(x)>1
factorial (x) where x<0 or x>48 or x is not an integer.

If any of the above should ccur, the current calculation s terminated and the opera-ional state is as if *N* had een entered.

It should be noted that calculated values will be given to 10 significant digits. For some of the above functions, however, the displayed value may not be accurate down to the last digit. This will depend on which functions are used. for example, the accuracy of the logarithmic function is taken as 0.0001%. It is suggested that the user consult the relevant sections of the *Microbee User's Manual* to obtain the accuracy of the various functions.

Minimart

FOR SALE: POWER SUPPLY IBM 63 W; 5V-7A, 12V-2A; −12V-0.25A; −5V-3A. Will run 1616 computer. $50. (062) 31-6219.

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WANTED: CIRCUIT DIAGRAM for B&K precision 3020 sweep/function generator. Made by Dynascan Corporation. Bill (03) 791-2976, Dandenong 3175.

WANTED: DRAKE R-7A, JRC NRD-515, REALISTIC DX-160, HAESU FRG-7 receivers also old 'QST' and 'Amateur Radio' mags. (042) 29 2573. Tony.

FOR SALE: ANTIQUE RADIO COLLECTION, valves, instruments, spare parts, books, catalogues, knobs. Max, 41 Willmington St. Newmarket, 4051, Qld. (07) 356 6052.

WANTED: A COPY OF NOV' 77 ETI, or a set of photostats containing the FREQUENCY SHIFTER project. Expenses paid. Bill Hirst, 12 Jeffrey St., Dandenong, 3125, Vic. (03) 791 2976.

FOR SALE: MONITOR AND CABINET only, from Burroughs terminal $20. Heatsink from frame with diodes 12 x 10.25 inches. Julian Sortland, Hornsby, NSW, (02)476-1056.

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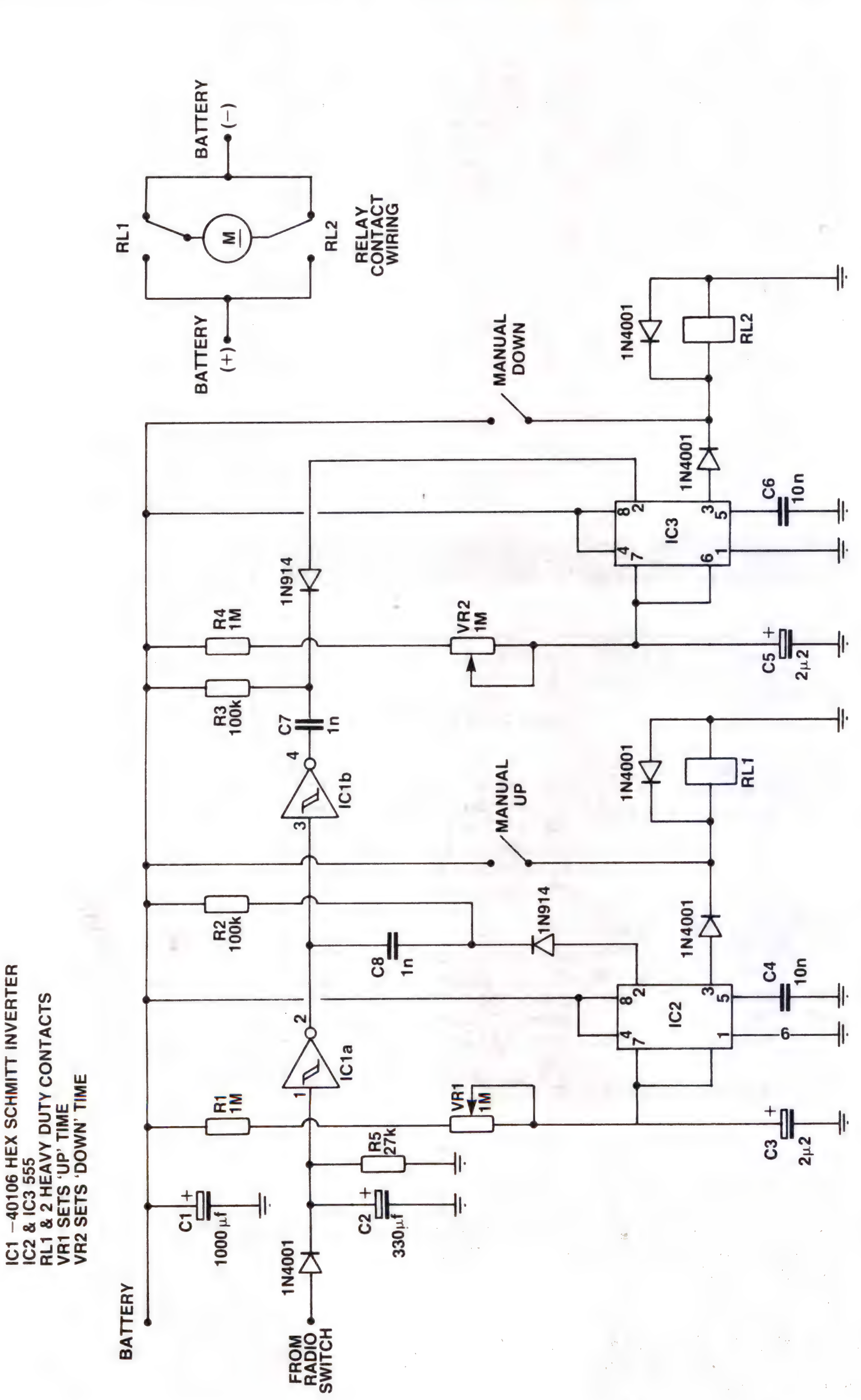


IC1 —40106 HEX SCHMITT INVERTER
IC2 & IC3 555
RL1 & 2 HEAVY DUTY CONTACTS
VR1 SETS 'UP' TIME
VR2 SETS 'DOWN' TIME

Automatic Car Aerial

The circuit is a modified or alternative version to that published in ETI Circuit Cookbook No 5, page 17 and has the following advantges:

★ Individual up/down adjustment (timing)

★ Relays driven directly from 555's (doing away with extra components, etc)

★ Manual up/down override

The circuit consists of a triggering circuit, two timing circuits and two relays, which in turn drive the aerial motor up or down. The input to the circuit is via the on/off switch. When the radio set is turned on, C2 charges rapidly, and the negative going pulse from IC1a (inverter) triggers the timer circuit IC5 (555) and associated components. The up relay RL1 is then activated for a time determined by R1, VR1 and C3. (VR1 being used to set this period accurately.)

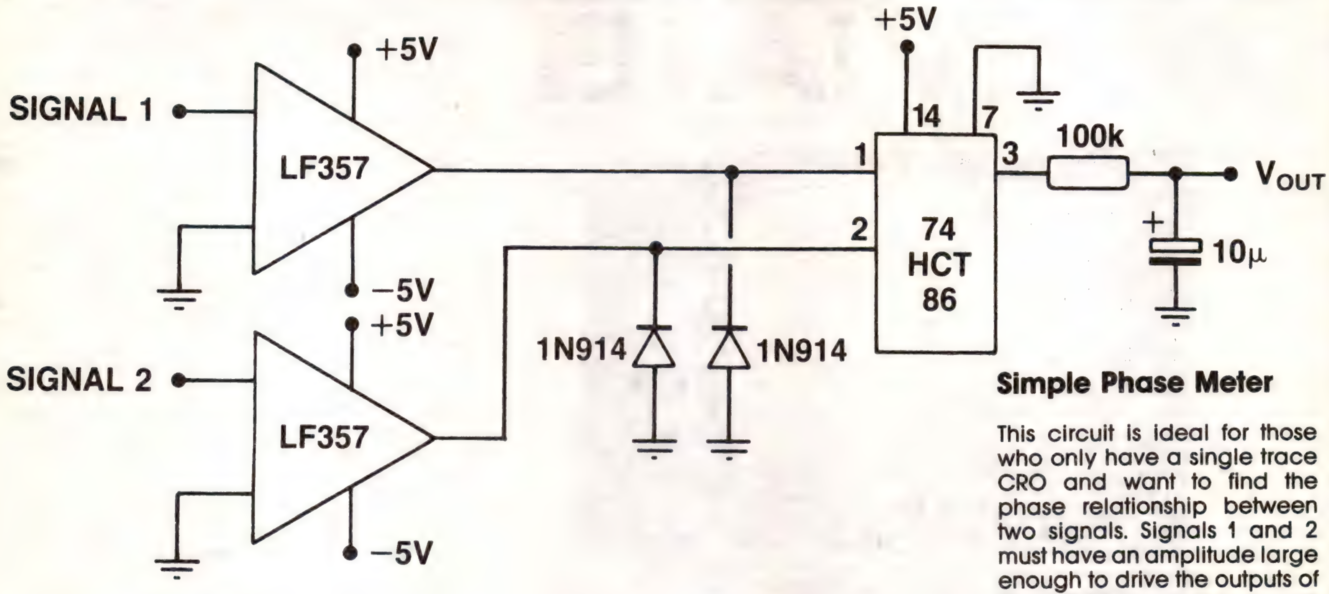
When the radio or the ignition is turned off the negative going pulse from IC1b triggers the timing circuit IC3 (555). Consequently the down relay is turned on for the period determined by R4, VR2 and C5. (VR2 being used to get the down period accurately.)

The combination of C2/R5 allows approximately 10 seconds delay prior to the aerial retracting. This allows for restarting the engine whilst the aerial is up.

Manual override of up/-down allows the aerial to be lowered and raised independently of the unit, which can be useful at times, especially in city driving, where reception can be sometimes improved by adjusting the aerial length.

Filtering of noise spikes has been achieved by the inclusion of C1, which has proved adequate in the prototype. The circuit should be fused and wired directly to the battery and not via the accessory switch. Heavy duty 12V contacts are a must due to the heavy current demands placed on them by the aerial motor surge.

V. Diana,
Vermont South,
Vic



Simple Phase Meter

This circuit is ideal for those who only have a single trace CRO and want to find the phase relationship between two signals. Signals 1 and 2 must have an amplitude large enough to drive the outputs of the LF357 to a rail to rail square wave. The phase difference is given by the equation: PD=(36.Vout) degrees. As an example, for a Vout of 2.5 volts the phase difference is 90 degrees.

A. J. Stewart
Pialba,
Qld

Feed Forward needs your minds. If you have ideas for circuits that you would like to enter in our idea of the month contest, programs for the computing columns or just want a word with the editor, send your thoughts to:

Feed Forward
ETI, Federal Publishing,
PO Box 227,
Waterloo, NSW 2017

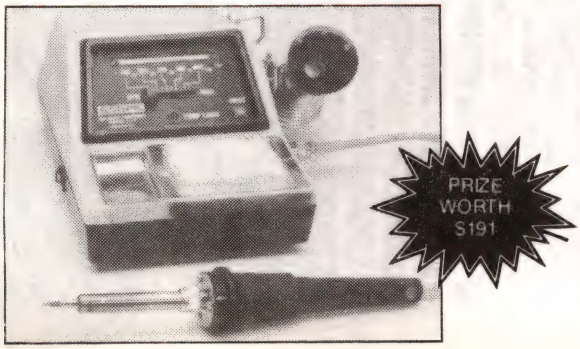
Contributors can look forward to $20 for each published idea/program which should be submitted with the declaration coupon below.

Programs MUST be in the form of a listing from a printer. You should indicate which computer the program is for. Letters should be typewritten or from a printer, preferably with lines double spaced. Circuits can be drawn roughly, because we have a draughtsman who redraws them anyway, but make sure they are clear enough for us to understand.

'Idea of the month' contest

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI Magazine. Each month, we will be giving away a Scope Soldering Station (model ETC60L) worth approximately $191.

Selections will be made at the sole discretion of the editorial staff of ETI Magazine.



RULES

The winning entry will be judged by the Editor of ETI Magazine, whose decision will be final. No correspondence can be entered into regarding the decision.

The winner will be advised by telegram. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI Magazine.

Contestants must enter their names and addresses where indicated on each coupon. Photostats or clearly written copies will be accepted. You may send as many entries as your wish.

This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

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Cut and send to: **Scope-ETI 'Idea of the Month' Contest/**
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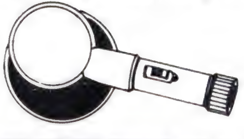

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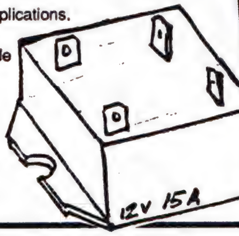

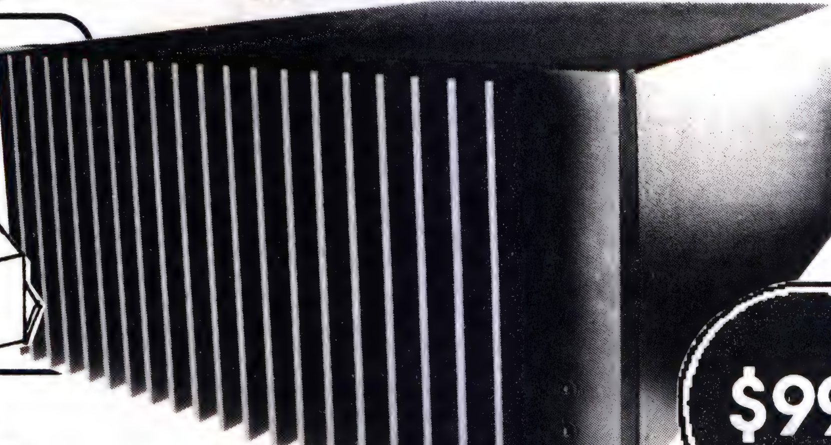

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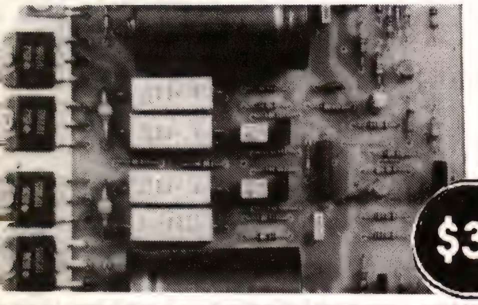

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100 WATTS INTO 4 OHMS/50 WATTS INTO 8 OHMS!

Ref: AEM January 1987

A genuine low cost power amp "slave" module. Keeps costs down by having power supply filter caps on board. All that is required to make module operational is ±30 - 40V (DC unfiltered), a signal source and a load. Works well with PA line transformers too. All board parts supplied including jig drilled heatsink bracket.

Cat. KM-3050

BRAND NEW KIT

AEM RTTY ENCODER

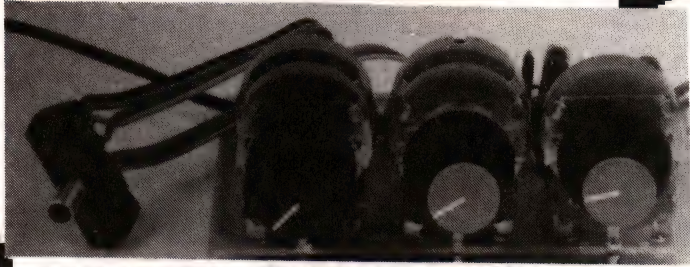
Companion for 'Listening Post'

Ref: AEM May/June 1987

Here's the low-cost way to get on the air with radioteletype (RTTY). This encoder teams up with the ever popular AEM 3500 Listening Post kit (Cat. KM-3015 $39.95) to make a complete transmit/receive tone decoder/encoder. Join the ranks of the thousands of amateurs around the world using the fascinating RTTY mode! Designed to connect in line between your AEM3500 Listening Post and your computer. The Jaycar kit comes complete with with case, Scotchcal front panel and connection hardware for "Listening Post". See AEM for software info.

Cat. KM-3016

$59.95



$23.50

ETI 1406 PARAMETRIC EQUALISER MODULE

Ref: ETI August 1986

Module can be used on its own or ganaged to equalise a whole system. Parametric equalisers tune around a centre frequency reducing the number of units required in a signal line (reducing distortion) over the more normal "grahic" equalisers.

The Jaycar kit is supplied with all board components including pots, knobs, switch and TL071 IC.

SEE THE 1987 JAYCAR CATALOGUE FOR SPECIFICATIONS

Cat. KE-4724

BRAND NEW KIT

BATTERY VOLTAGE METER

- Ref: EA May 1987

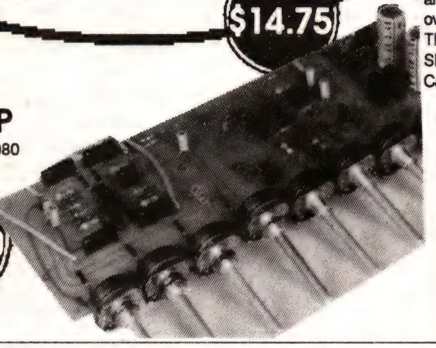
This simple project connects directly to the battery in your car. It will indicate under-normal - or overcharging via a bar display of yellow green and red rectangular LEDs. Can be mounted on dash of car. All specified board components supplied.

Cat. KA-1684

$14.75

ETI467 MIXER PREAMP

Ref: ETI July 1980



$39.50

PLAYMASTER 60-60 AMPLIFIER - BLUEPRINT VERSION

The interest in the Playmaster 60-60 has been absolutely tremendous. We have not had such interest in a kit since the 5000 amp was released! When we released the 'Black Monolith' 5000 series amp it was extremely popular. People appreciated the quality refinements to the kit.

Well we now have a 'Blue printed' version of the Playmaster 60-60. We believe what is shown below represents a significant improvement in the development of this project.

★ Dual diagonally wound C-core power transformer. Endorsed in writing (with each kit) by EA. Slightly higher power rating than toroid power transformer (which is in the standard kit).

★ For lower noise, metal film 1% 50ppm resistors are now supplied where 5% carbon types were originally specified.

★ Power supply filter capacitors - Doubled! That's right, the Blueprint amp has 4 x 4700uF/63V filter capacitors instead of the 4 x 2200uF types in the standard version. This is a significant improvement in power supply performance!

★ Special extruded heatsink. The heatsink section is machined from a heavy section extruded aluminium section. It is then black anodised. The standard heatsink is folded sheetmetal not anodised.

★ Special high quality pretinned PCB

★ Special front panel graphics emphasising the Blueprint treatment to the amp.

We feel that this is a tremendous development in kit amp construction, especially when you consider the modest price!

The standard 60-60 kit Cat. KA-1650 is still available for $299. But the new Blueprint amp is an absolute bargain at only $349! That's right, you can have the Blueprinted version of the kit for only a little more!

When the 5000 'Black Monolith' blueprinted amp came out we could not keep up with demand. Customers were happy to wait up to 6 months! We do not expect this to be the case with the 60-60 but if you are contemplating the purchase of one of these fine kits (there is nothing wrong with our standard kit, by the way) we suggest that you buy soon!!

Cat. KA-1652

BLUEPRINT 60-60

A JAYCAR SCOOP PRODUCT

Illustration shows standard 60-60 panel livery. Special livery only on the Blueprint version.

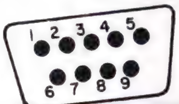
$349

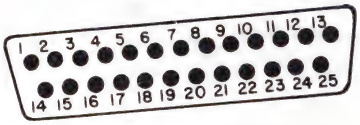
LOWER EVERYDAY PRICES ON CENTRONICS AND 'D' CONNECTORS

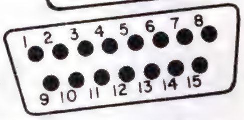
These are NOT a special for one month only, these are our NEW LOWER everyday prices.

WERE	TYPE	1-9	10 UP	100 UP INC TAX	Cat. No
$2.75	9 pin Male D	$2.25	$2.00	$1.20	PP-0800
$3.50	9 pin Female D	$2.75	$2.50	$1.60	PS-0804
$2.20	9 pin Backshell	$1.90	$1.80	$1.20	PM-0808
$3.25	15 pin Male D	$2.50	$2.25	$1.40	PP-0820
$3.95	15 pin Female D	$2.75	$2.50	$1.60	PS-0824
$5.75	15 pin Female R/angle	$3.50	$3.25	$1.80	PS-0826
$2.20	15 pin Backshell	$2.00	$1.80	$1.25	PM-0828
$3.95	25 pin Male D	$2.95	$2.70	$1.70	PP-0840
$5.25	25 pin Female D	$3.50	$3.20	$1.80	PS-0844
$2.20	25 pin Backshell	$2.00	$1.80	$1.25	PM-0848
$12.50	25D IDC Plug	$8.50	$8.00	$6.00	PP-0842
$12.50	25D IDC Socket	$9.00	$8.50	$6.25	PS-0846
$12.50	Centronics Plug	$7.50	$7.00	$5.00	PP-0890
$12.50	Centronics IDC Plug	$8.50	$8.00	$5.75	PP-0892
$15.95	Centronics Socket	$9.95	$9.50	$6.75	PS-0895
$17.50	Centronics IDC Socket	$12.50	$11.50	$8.00	PS-0896

SAVE UP TO 40%







NEW PRODUCTS

75 ohm air spaced coax	WB-2006
$1.20/m	
BNC crimp male plug	PP-0654
$2.20	
Heatsink compound large tube	NM-2010
$18.95	

NEW RECTIFIER DIODE

6 AMP 1000V

Cat. ZR-1024 **$1.50 ea**

10 up $1.30 ea

CAR BRAKE LIGHT

For safety sake you need one of these. Easy to install. Mount it on your rear parcel shelf, and it allows several cars travelling behind you to see when you hit the brakes. Soon to become compulsory on new cars.

Cat. XM-0600

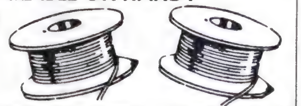
$12.95

CONCORD NOW OPEN SATURDAY MORNINGS

AUTOMOTIVE ELECTRICAL CABLE

For all those wiring jobs on cars, boats, trucks, caravans and even electronics. Cable is 16/0.30 3mm diameter, 6 amps. Length is 9.25 metres supplied on a plastic spool. 7 colours available.

NOW AVAILABLE ON HANDY 9m REELS



RED	WH-3080	GREEN	WH-3084
BLACK	WH-3081	BLUE	WH-3085
BROWN	WH-3082	WHITE	WH-3086
YELLOW	WH-3083		

ONLY $3.99 REEL

or buy all 7 for only $22.95

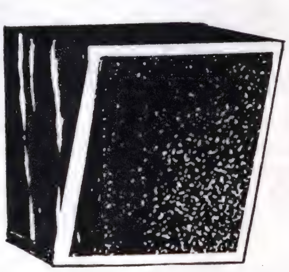
Cat No. when buying all 7 - WH-3090

SAVE $5.00

8" PA SPEAKER BOX

Quality woodgrain finish speaker box. Designed to hang on a wall for PA use, or just as an extension speaker for Hi Fi, radio, etc.

Cat. CB-2360



SPEAKERS TO SUIT:

8" 10 watt twincone Cat. CE-2325 $11.95
Magnavox 8JX 40 watts CE-2333 $28.50
Magnavox 8WR 65 watts CE-2338 $34.50

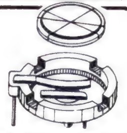
ONLY $24.50

10 up $22.50

BUTTON CELL BATTERY HOLDER

- PCB Mount
- Will take all common silver oxide cells + small lithium batteries etc.
- Gold plated contacts

Cat. PH-9225 **$3.95** **10 UP $3.50 ea**



TURN YOUR STOCK INTO CASH! - Jaycar will purchase your surplus stocks of components and equipment. We are continually on the lookout for sources of prime quality merchandise.

CALL GARY JOHNSTON TODAY ON (02) 747 2022 OR FAX (02) 744 0767

CAR ALARM REMOTE CONTROL BATTERY

Quality Alkaline 6 volt No. A544 battery suited for most car alarm remote controls. Size 44mm long, 12mm diameter.

Cat. SB-2397 **$8.50**

CARLINGFORD NOW OPEN SATURDAYS UNTIL 2pm

MAINS MUFFLERS

This fully approved Electricity Authority unit is the ultimate mains suppression device. It is fitted with a circuit breaker and VDR's for extra suppression capacity. Nothing but clean 240V goes through. Recommended for computers - VDU's - printers - disc drives - video - medical equipment.

Max load 1000 watts 4 amps 250V.

TWO OUTLETS

Cat. MS-4040

$149.00

FOUR OUTLETS

Cat. MS-4042

$249.00

IEC-TYPE MAINS INPUT FILTERS

3 AMP

The filter is rated at 250V 3 amps. 1/4" Q.C. type terminals are on the top for simple internal mains connection. Type IEC-320 recessed chassis plug on the side.

SPECS:

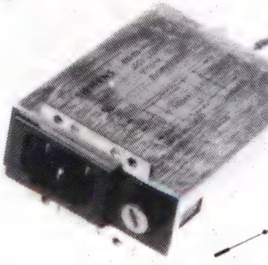
Input: 115-250V AC
47 - 63Hz
3A continuous

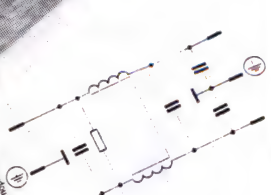
Size: 38(D) x 63(H) x 50(W)mm excluding terminals.

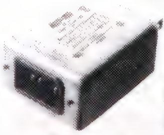
Cat. MS-4004

$19.95 ea

10 up $17.95 ea







4 AMP

Basically the same as the 3 amp version, except it's 4 amp and it's fused. Accepts 3AG fuses.

Cat. MS-4006 **$29.95**

8 AMP

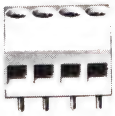
For those big jobs. Again much the same as the 3 amp one - but 8 amps.

Cat. MS-4005 **$29.95**

JAYCAR No.1 FOR MAINS FILTERS

PCB SCREW MOUNT TERMINALS

		10 up	
2 way	$1.10	$1.00	HM-3172
3 way	$1.40	$1.25	HM-3173
4 way	$1.65	$1.50	HM-3174
5 way	$2.00	$1.80	HM-3175
6 way	$2.40	$2.20	HM-3176
8 way	$2.95	$2.70	HM-3178
12 way	$4.25	$4.00	HM-3182



IDEAL FOR PROJECTS

GORE HILL OPEN SATURDAYS UNTIL 4pm

JAYCAR JAYCAR
JAYCAR JAYCAR
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INPHONE Cordless Phone

Features:
- Simple to use and easy to install - just plug in
- Operating range up to 250 metres (800ft)
- Security code system with 16,348 combinations
- Call function at base unit to alert handset
- Pulse dialling with audible tone feedback at the touch of a key

Cat. YT-7065

DON'T PAY $295

ONLY $269

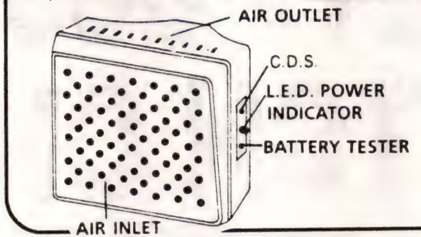
FRIGI-FRESH

ELECTRONIC REFRIGERATOR DEODORISER

Frigi-Fresh automatically circulates the air inside a refrigerator after each door opening. Air is drawn thru the inlet grille (shown). It passes through a special filter that absorbs odours. The Frigi-Fresh automatically turns itself off approx 12 seconds after the door is closed.

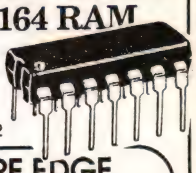
Cat. YF-5522 (inc. filter)
Spare filters Cat. YF-5523 $3.00 each
Requires 4 x AA cells (not supplied)

$24.95



NEW LOWER EVERYDAY PRICES ON 4164 RAM

200ns	150ns
1-9 $2.95	1-9 $3.50
10 up $2.50	10 up $3.25
100 $1.80	100 $2.20
Cat. ZZ-8420	Cat. ZZ-8422



COMMODORE EDGE CONNECTOR

Cat. PA-0888

$6.95

POLYSWITCHES

Ref: EA July 1986

The very latest in speaker protection. Polyswitch protectors are based on conductive polymers and act like resettable solid state circuit breakers.

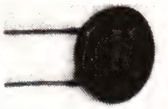
RN3410 is suitable for protection of tweeters in systems up to 100 watts. It's rated at 50V & 0.5A. Nominal resistance is 0.4 ohms.
Cat. RN-3410

RN3415 will protect midrange and woofers up to 100 watts. Rated at 50V & 1.15A. Nominal resistance is 0.12 ohms.

BOTH UNITS

$6.98 ea

10 or more
$6.50 each



Sensational

Ultrasonic Pest & Insect Repeller

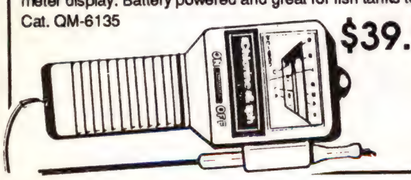
This one is $15.50 cheaper than last year!
It will control mice, rats, roaches, crickets, silversfish, waterbugs, moths, etc.
Size: 100 x 90 x 80mm.
Power adaptor supplied 240V/9V DC. Output level 130dB from 30kHz to 65kHz.
Cat. YS-5510

ONLY $39.50

pH CHLORINE METER

Two probes coming out of one end of this hand held device are inserted into the water to be tested. An instant reading of the Chlorine level and pH value is given on the panel meter display. Battery powered and great for fish tanks too!
Cat. QM-6135

$39.95



RECHARGEABLES & CHARGERS

PENLIGHT NiCads

Don't keep wasting money buying throw-away batteries. Step up to NiCad rechargeables.

SUPERB ROCKET BRAND AA PENLIGHT 450mA

Cat. SB-2452

$3.50 ea

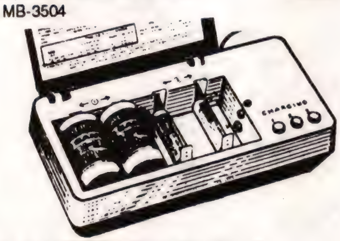
4 for $12

UNIVERSAL NiCad CHARGER

Features:
- Operates from 240V mains
- Accepts AA, C, D & 9V NiCads
- Charges singly or in groups
- Charge different size units together
- Charging indicator lamp at each battery position
- Incorporates battery test facility

Cat. MB-3504

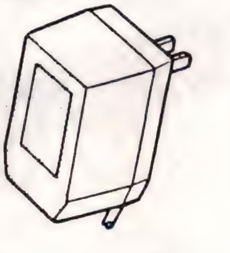
$32.50



GEL BATTERY CHARGER

This handy charger will recharge your Gel batteries. Delivers 300mA current at 12 volts DC. Supplied with quick connect lugs for easy connection to the battery.
Cat. MP-3506

$13.95



LEAD ACID RECHARGEABLE

Ideal for alarms or anywhere where constant use depletes batteries quickly.

12 VOLT 1.2A/H Cat. SB-2480	$28.50
12 VOLT 4.5A/H Cat. SB-2486	$49.50

MULTI-FUNCTION NiCad CHARGER

This one does everything!
FEATURES
- Charges 8 - AAA, AA, C or D cells at once
- Charges 3 to 9V cells via universal connector
- Charges 3, 6 and 12V Gel batteries
- Charges button cells
- Test meter and LED charging
- 240V operated

Cat. MB-3508

$59.50

BATTERIES NOT INCLUDED

SOLAR BATTERY CHARGER

The solar panel in the lid will charge up to 4 x AA NiCads in a fairly short time. It is ideal for yachts, campers, or anywhere where 240V is not available.
Cat. MB-3502

$17.95

Jaycar ELECTRONICS

POST & PACKING

$5	$9.99	$ 2.00
$10	$24.99	$ 3.75
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$50	$99.99	$ 6.50
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HURSTVILLE	121 Forest Rd (02) 570 7000 - Mon-Fri 9 - 5.30 Thurs 8.30 pm - Sat 9 - 12
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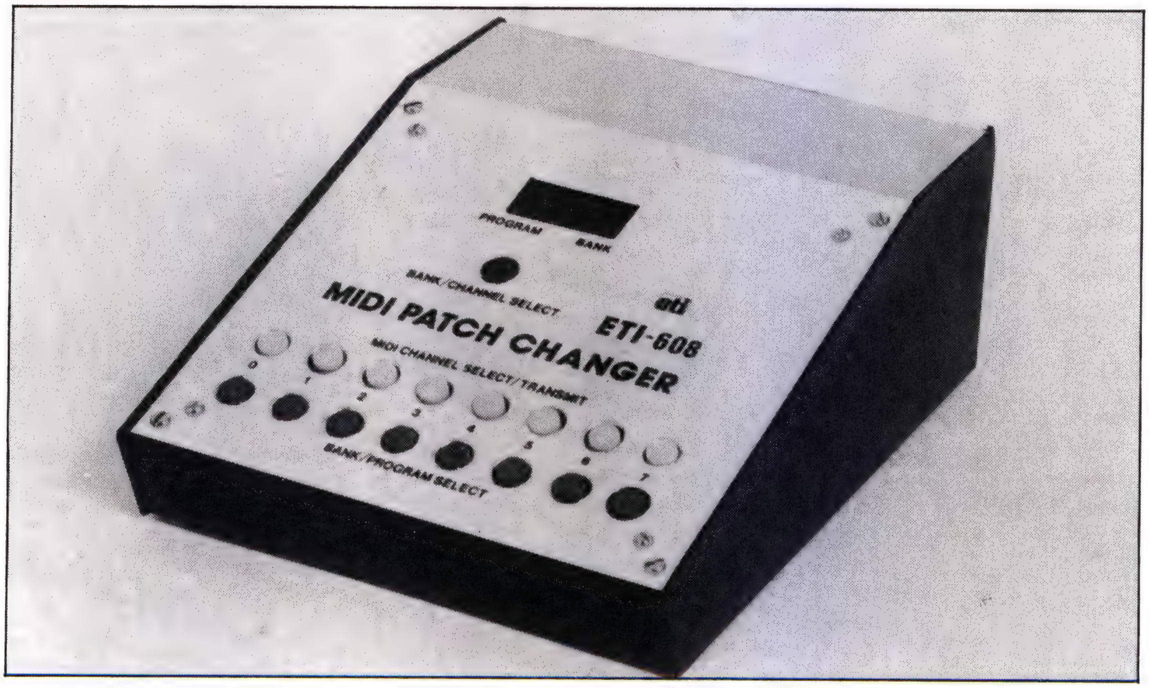
ETI 608 MIDI PATCH CHANGER

This is the third in a series of simple MIDI devices to help the serious electronic musician join all his devices together. For a third the price of a bought one, you too can own a Patch Changer.

Simon Leadley and Terry Kee*

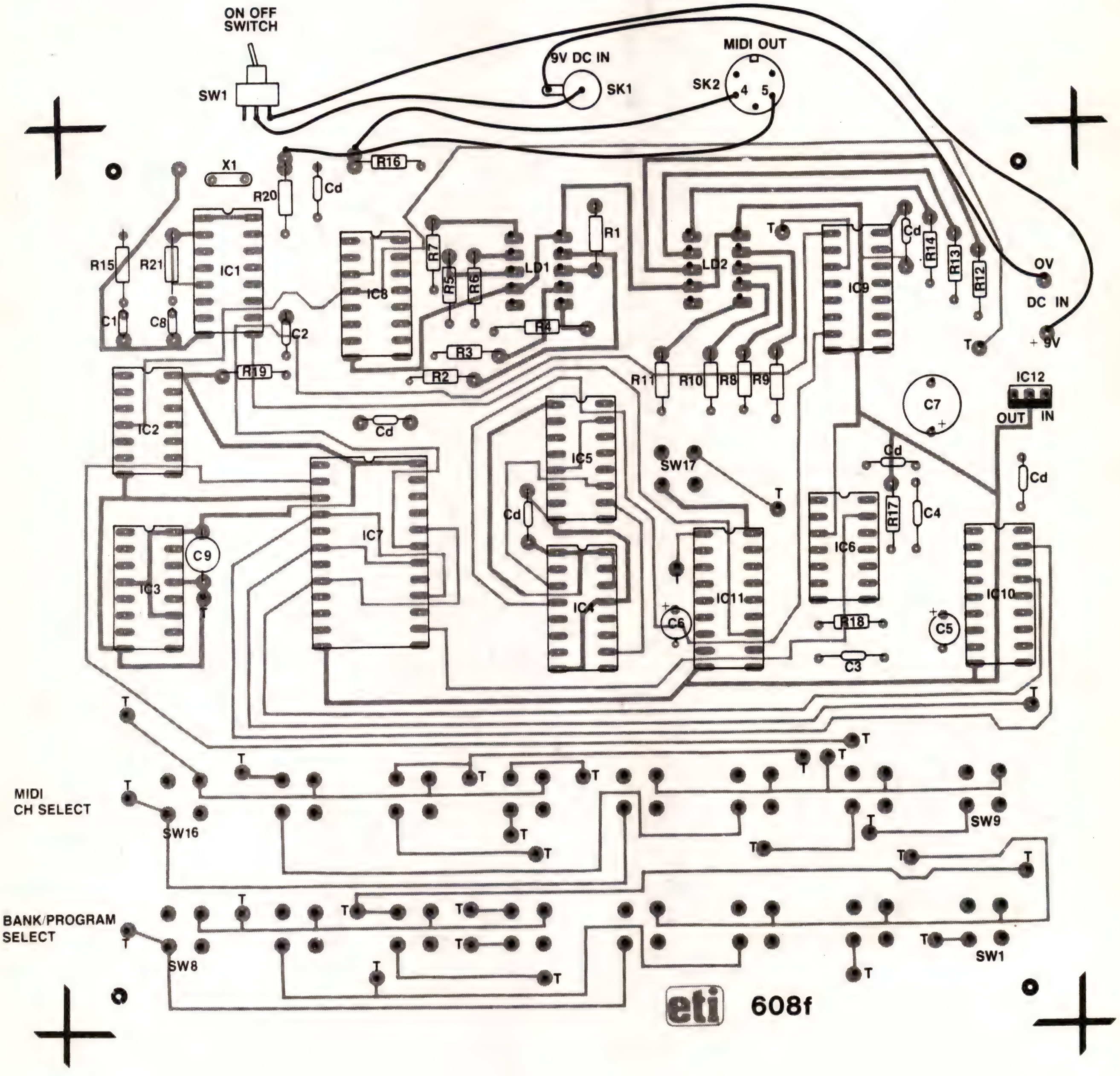


MIDI (Musical Instrument Digital Interface) is a communications protocol that allows computer musical instruments to talk to each other. In the beginning, MIDI was used almost exclusively on synthesisers and drum machines. However, it is now beginning to appear on all sorts of instruments. Most of the latest generation of digital effects units are MIDI compatible, as are light introduction controllers, and even the latest electric guitars. For a good introduction to MIDI read 'Real Computer Music' by Neale Handcock (ETI October 86).

As the amount of MIDI gear expands the communications network between all the instruments is becoming very complex. In fact, controlling it in real time is becoming something of a nightmare. Hence the need for a device to select pieces of music easily.

Enter the Patch Changer. It is designed to select a patch (predefinable program on a device) from up to eight channels connected together. Each MIDI device is assigned a channel on the MIDI buss. The patch changer can then select a channel and transmit a request for the machine on that channel to switch itself into a particular configuration.

MIDI devices usually have a number of patches in a memory space on-board. These may be defined in terms of eight banks, each with eight patches, or simply in terms of 64 patches numbered from 1 to 64. Some of the latest machines go overboard with from one to 99 user definable patches. This is probably overkill, since it's impossible to keep track of 99 patches. Because of the differences between the various types of machines, and also to simplify the decoding circuitry, we decided to follow the simplest MIDI convention, which is to have eight banks and eight programs, numbered from zero to



seven. In operation, the difference between the number displayed on the machine, and the number on the ETI 608 is not a problem, since the operator defines everything in terms of the 608.

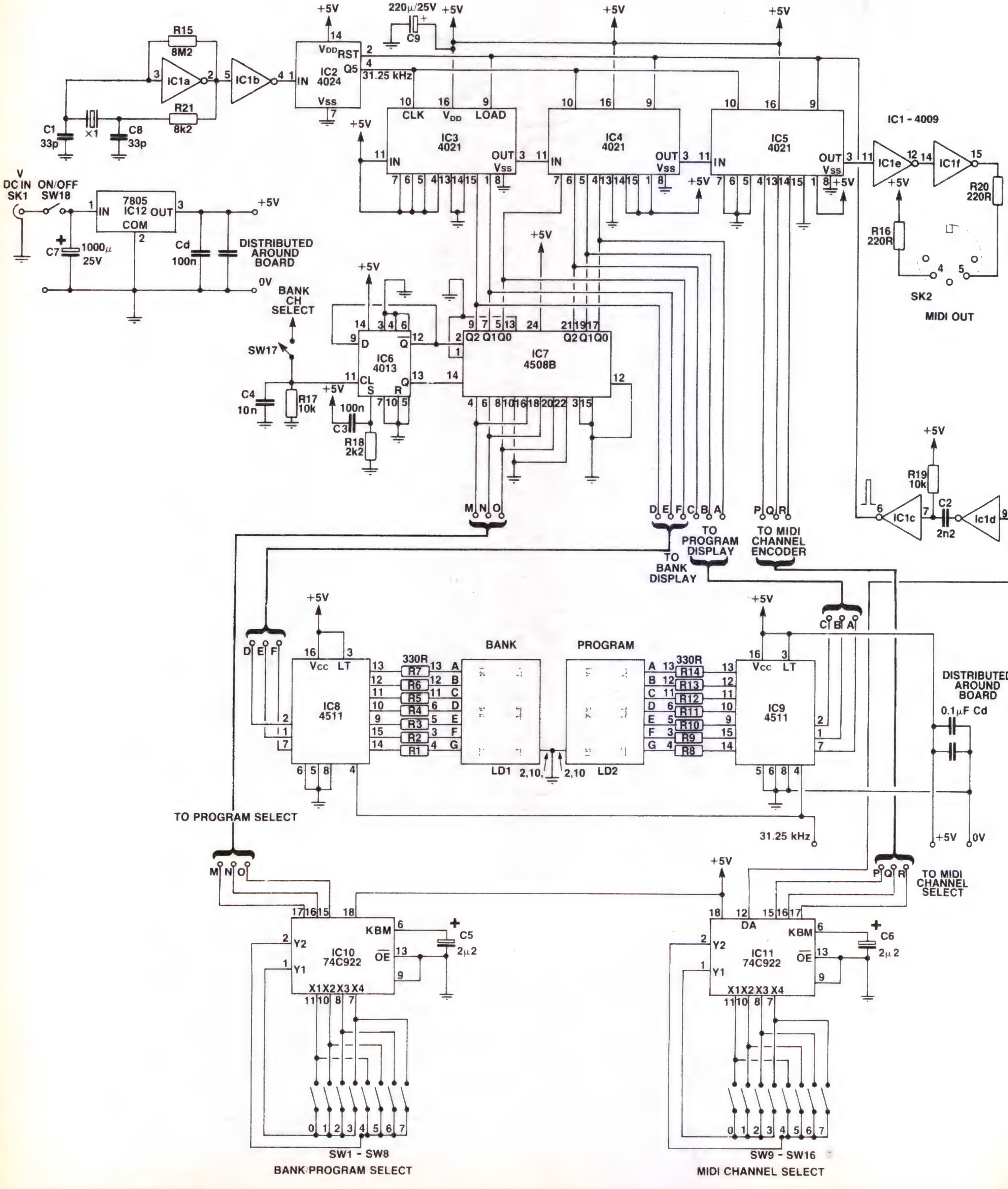
Construction

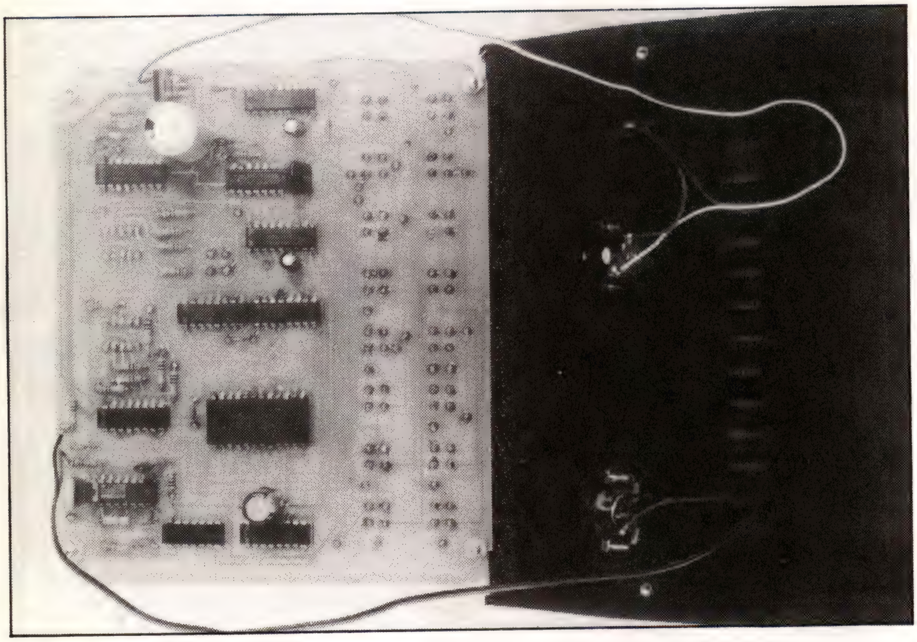
The whole project is built on a double sided pc board. First check that there are no short circuits between the tracks, especially when they run between IC pads. Also check that none of the tracks are open circuit. When you are satisfied with the board, install the through pins. (To keep costs down we don't have plated through holes.) You will find that there are 29 wire links that need to be installed, all designated by a 'T' on the overlay.

Next install the resistors and capacitors, being careful to align the electrolytics correctly. There are four of them, with their polarities marked on the overlay. Notice that there are pads on both sides of the board at every hole. If there are tracks coming to the pad, you need to solder the component to it. You will find that sometimes you need to solder one side, sometimes the other, and in many cases both sides. In fact, just to be sure, you might want to solder every component on both sides of the board.

Next solder in the flying leads and the appropriate plugs, making sure that you leave enough wire to make the connection to the appropriate place. About twice the length of the board will be plenty. Now mount the crystal and the ICs.

The IC section needs some consideration as there are two ways to proceed. You can solder the ICs directly to the board on both the top and bottom where necessary if you wish, but remember the ICs are all CMOS, and therefore more prone to damage as a result of careless handling. Good practise is to avoid touch-▶


+5V
220µ/25V
C9
R15
8M2
R21
8k2
IC1a
IC1b
IC2
4024
VDD
RST
Q5
31.25 kHz
IN
Vss
C1
33p
X1
C8
33p
CLK
VDD
LOAD
IC3
4021
IC4
4021
IC5
4021
IN
OUT
Vss
IC1 - 4009
IC1e
IC1f
R20
220R
R16
220R
SK2
MIDI OUT
V
DC IN
SK1
ON/OFF
SW18
7805
IC12
IN
OUT
COM
C7
1000µ
25V
Cd
100n
DISTRIBUTED AROUND BOARD
0V
BANK CH SELECT
SW17
C4
10n
R17
10k
C3
100n
R18
2k2
IC6
4013
D
Q
CL
S
R
IC7
4508B
Q2 Q1 Q0
M N O
D E F C B A
TO PROGRAM DISPLAY
TO BANK DISPLAY
P Q R
TO MIDI CHANNEL ENCODER
R19
10k
C2
2n2
IC1c
IC1d
IC8
4511
Vcc
LT
330R
R7
R6
R5
R4
R3
R2
R1
BANK
PROGRAM
LD1
LD2
2,10
R14
R13
R12
R11
R10
R9
R8
IC9
4511
DISTRIBUTED AROUND BOARD
0.1µF Cd
TO PROGRAM SELECT
31.25 kHz
+5V
0V
TO MIDI CHANNEL SELECT
IC10
74C922
Y2
Y1
KBM
OE
X1 X2 X3 X4
C5
2µ2
SW1 - SW8
BANK/PROGRAM SELECT
IC11
74C922
DA
C6
2µ2
SW9 - SW16
MIDI CHANNEL SELECT



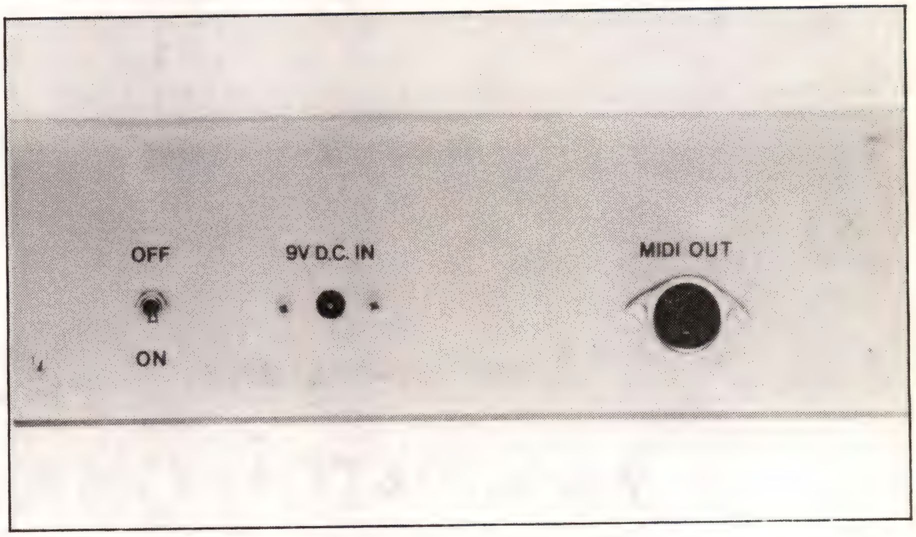
ing the pins, and to solder −Vdd (bottom left hand) and +Vcc (top right hand) pins first. Be especially careful of the 74C922 keyboard encoders as they are very sensitive.

Of course, if you do solder them in on both sides they will be impossible to remove without first destroying the IC. As a result you might want to consider option 2. This uses Molex pins to mount the ICs. This has the advantage of making it simple to mount the chip and facilitates fault finding. It's also quicker, easier and neater. Break off a strip of pins and solder them on both sides of the board, leaving the alignment strip in. Do this for all the ICs. This done, insert the ICs, check the orientation against the diagram and then remove the alignment strip. Do it this way as it makes it easier to install the IC.

Next, turn the board over and place the two rows of switches and the bank/program selector switch. Align the switches so that the flat edge faces the top of the pc board. Solder them in on the component side. Now mount the seven segment displays. These should stand proud of the board so as to ensure that none of the other components touch the top of the box. The easiest way to do this is to cut down two 14 pin DIL sockets to 10 pins and then solder them in. Insert the displays in the sockets.

At this point you can admire/check your work as the case may be. Confirm that all the components are on one side of the board, and all the switches and the displays on the other. Then connect a suitable 9V power source and switch on. If the display lights up with some numbers then you are half way home. If it doesn't, switch off immediately and start checking your work even more carefully. The first things to suspect are the links from one side of the board to the other. Check them with a multimeter, as well as places where component leads are used as conducting paths from one side to the other.

If the unit works so far, connect the DIN plug and a MIDI keyboard or effects ▶



ETI-608 HOW IT WORKS

MIDI consists of a string of bytes. The first byte defines the program changes command and the MIDI channel command. The second defines the actual program change number. In this case between 0 and 63. All we need to do is set up the data for the two bytes and transmit them out, and ensure that each bit has the appropriate value. Since each MIDI byte consists of eight data bits, a start bit and a stop bit, it is actually ten bits long.

We need twenty bits to define the two bytes, hence the need for three parallel to serial converters. For simplicity and availability we chose the 4021.

To change the MIDI CHANNEL and the Program number we have used 74C922 Keyboard encoder. (IC10 and 11). These include scanning logic, can encode 16 keys and with the inclusion of keyboard debounce output a binary number on pins 15, 16 and 17 representative of the button pressed. We have only implemented 8 buttons as we have 8 MIDI channels. The outputs of IC11 drive a 4021 directly, while in the case of the Bank/Program encoder (IC10) drive a Dual 4 bit latch, IC7, to save an extra 8 switches and key encoder. The D type flip top IC6 controls the latching of the data at the input of the latch allowing you to change the program in increments of 8 or 1. The data from the latch also goes to the display decoders to display the data on the inputs to the 4021 and hency display the value of the program change. When the bank channel select button is pressed the DA output of IC11 goes low. This is converted to a narrow pulse by R19 and C2 and this loads the data at the inputs of the 4021's and initiates serial transmission at the rate determined by the clock input. The serial output stream is buffered by IC1e and IC1f and forms the current loop source that will drive the opto coupler at the receiver end.

The MIDI clock is a 31.25 kHz oscillator and this is derived from a 2 MH$_3$ crystal that is divided by 64 by the 4024 binary counter (IC2), and then fed to the clock inputs of the 4021s as well as the Display decoders (IC8 and IC9) to strobe the displays and reduce current consumption. The 5 volts is derived from a 9v plug-pak regulated and filtered by a 1000µf cap (C7) and the 7805 regulator IC12.

Current consumption for the unit is a maximum of 60 mA with the displays full on. So a 300 mA plug-pak is recommended to keep ripple to a minimum.

unit, power up and select a patch on the unit via the bank/program numbers and the bank/program selector, then send it out on the MIDI channel to which you have assigned the keyboard. The patch will change unless:

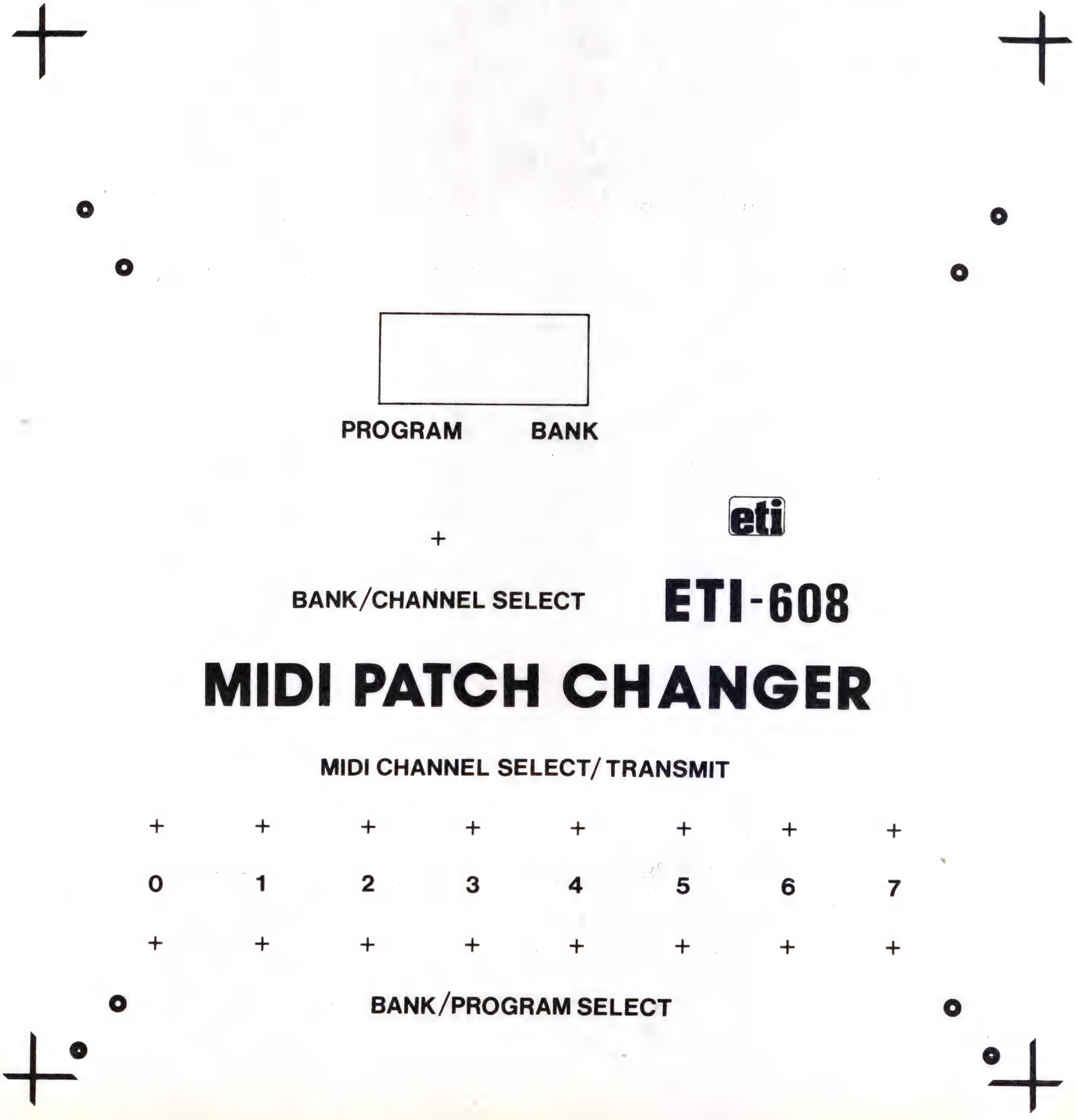
a: the unit is not working.

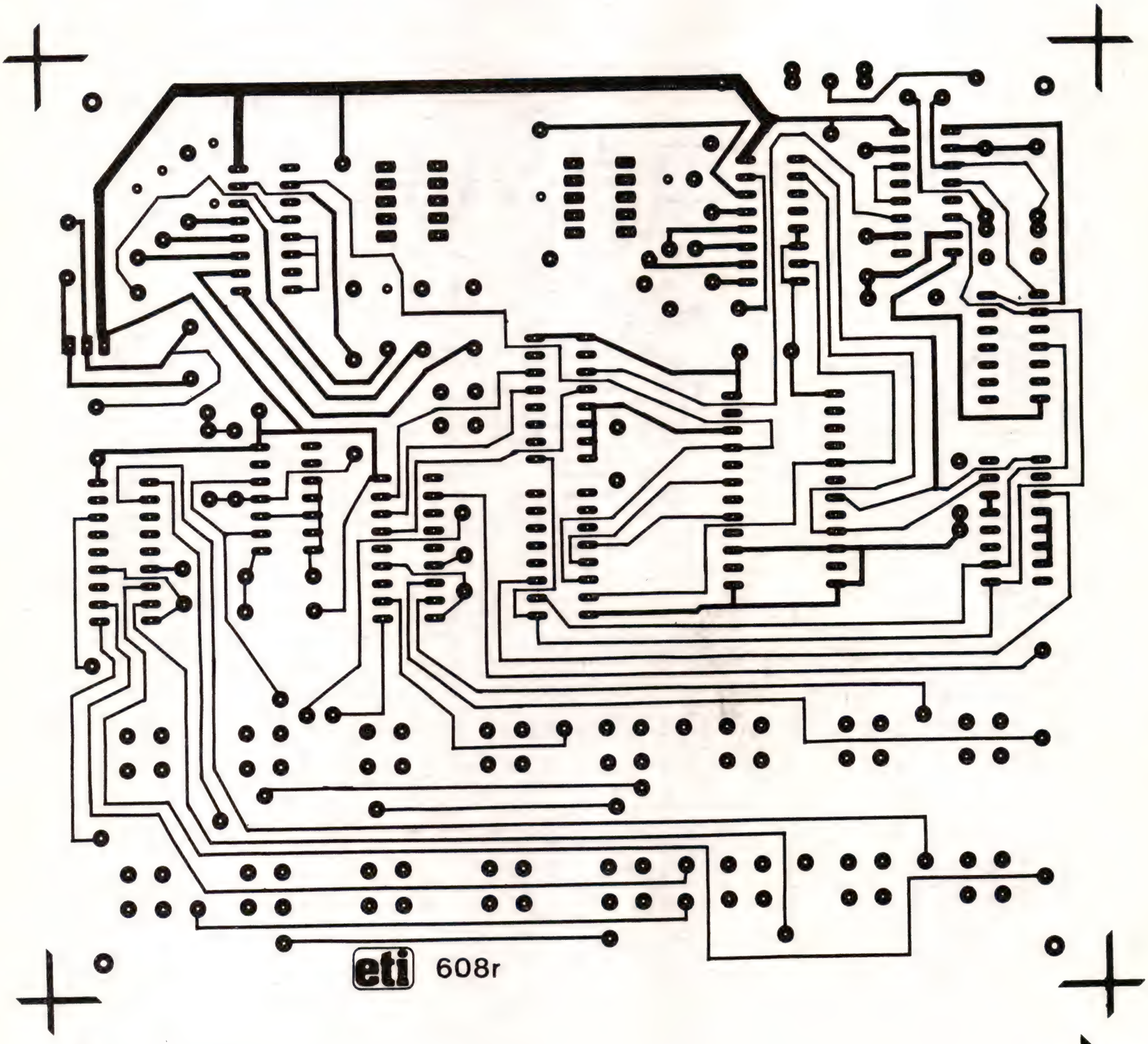
b: the receiver is on a different MIDI channel.

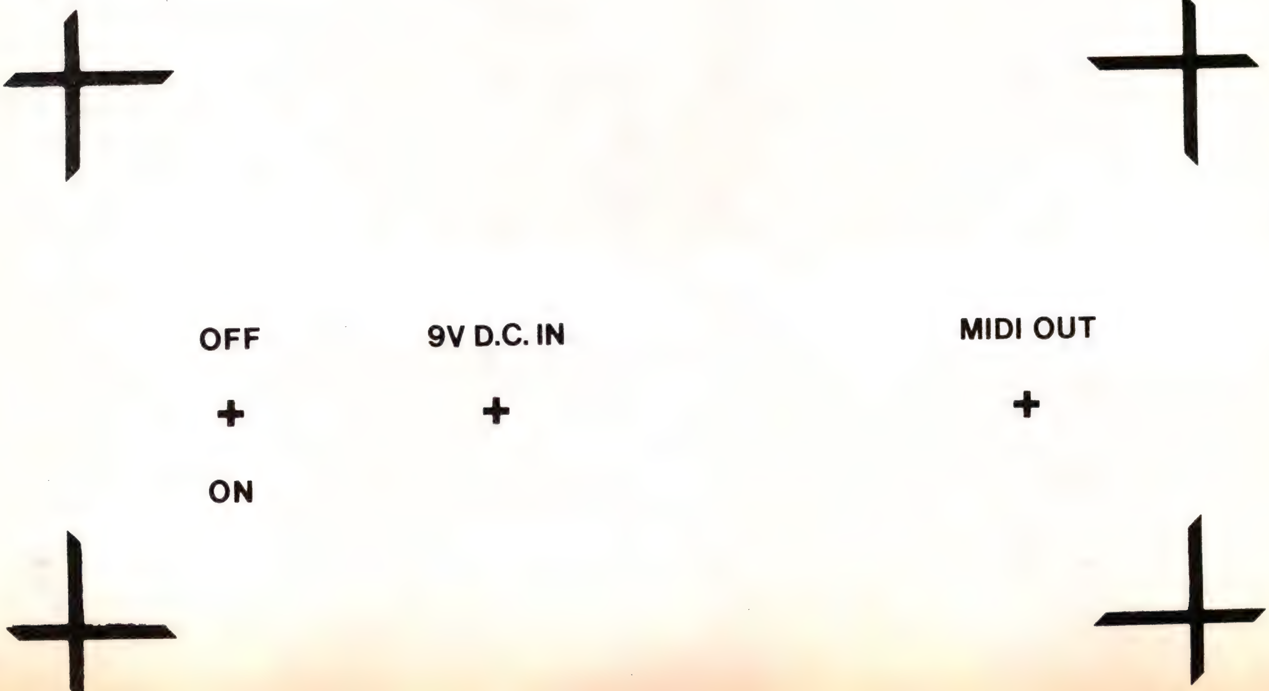
c: the receiver is already set to the patch you select.

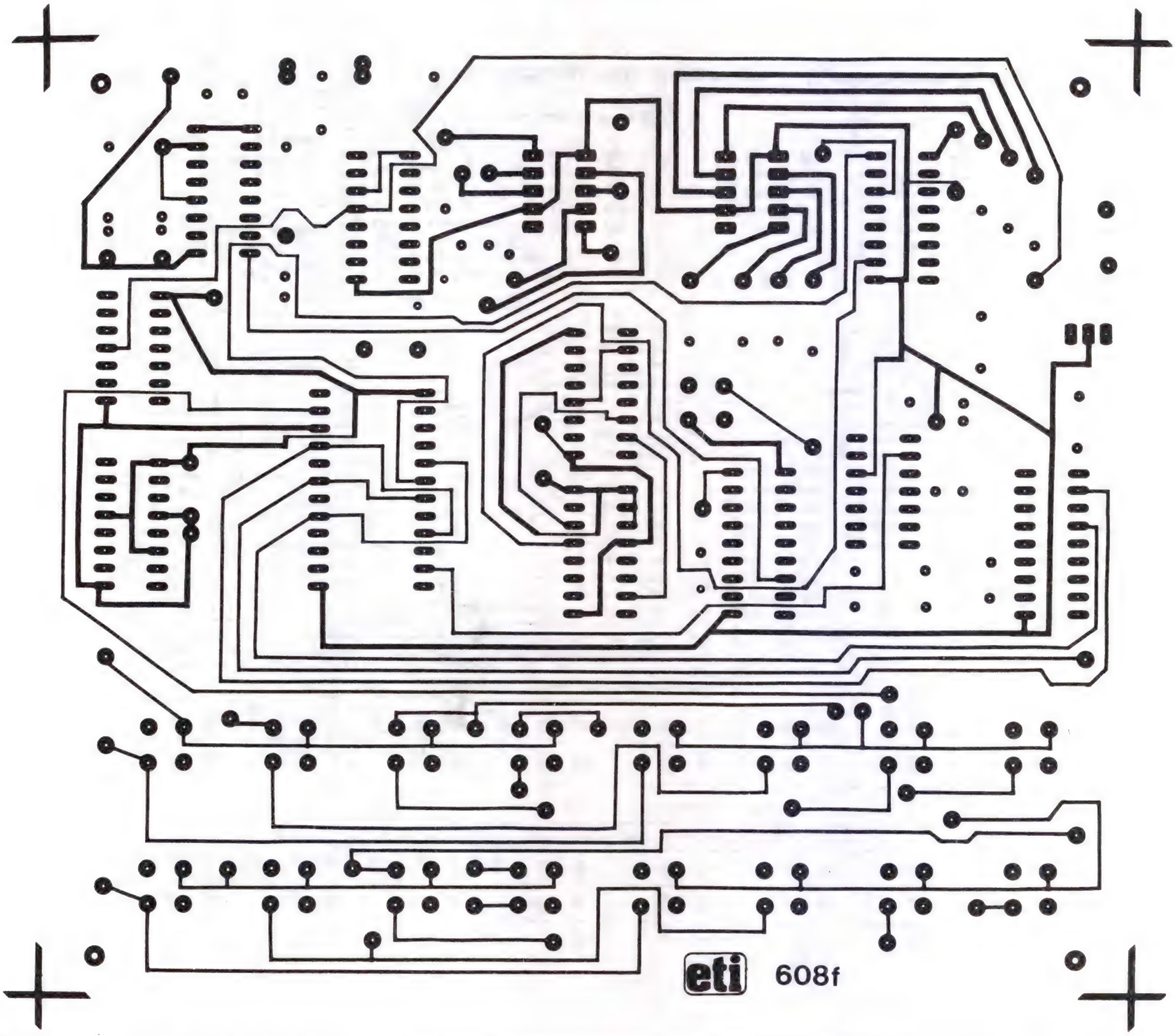
If all is well then assemble the unit in a box by placing the scotchcal panel on the lid and using it as a template for drilling holes for the buttons and the circuit board mounting bolts. Don't stick the panel down yet. Firstly use a bit of sticky tape to hold the panel without it moving. Then use a punch to mark the box by placing it on the centre of each cross marked on the panel. Then remove the panel and drill the holes, being careful to place the drill in the centre of the indent created by the punch. After drilling check to see that everything aligns correctly. In order to centre some of them, you might find it necessary to resolder some of the switches. Finally, use a small drill to drill out the hole for the displays. Drill around the hole until the bit in the middle falls out, then go to town with a file. It's a terrible job, but keep at it until its nice and square. Now remove the backing from the scotchcal and stick it down. The sharper the knife, the better the result. We actually used a surgical scalpel.

▶




eti 608r


OFF
ON
9V D.C. IN
MIDI OUT



Finally, mount the board in the box. Use stand-offs to keep the board away from the lid. You will need to adjust the height so that the displays are flush against the perspex. Screw in all the sockets on the back panel, bolt the lid down and you're ready to go.

Operation

To operate the unit simply dial up the patch number that you desire on the LED display using the bank/number buttons and the bank/number selector. Press one of the buttons in the bank/program select row, then the bank/channel select button and that number will appear as the "program". Now press a number again and it will appear as "bank". To transmit simply press the desired MIDI channel. ●

** Simon Leadley is at Tracktown Studios, Bondi Junction, Sydney. Terry Kee is on the staff of ETI.*

ETI-608 Parts List

Resistors	all 1/4 W,5%
Ri to R14	330R
R15	8M2
R16,R20	220R
R17,R19	10k
R18	2k2
R21	8k2
Capacitors	
C1,C8	33p ceramic
C2	2n2 greencap
C3	100n greencap
C4	10n greencap
C5,C6	2µ2 /25V electrolytic
C7	1000ν/25V electrolytic
C9	220µ /25V electrolytic
Cd	100n /25V ceramic 6 off
Semiconductors	
ICI	4009B CMOS Hex Inverting Buffer
IC2	4024B CMOS 7-Stage Binary Counter
IC3,IC4,IC5	4021B COMS 8-Stage Shift Register
IC6	4013B CMOS Dual D-type fliptop
IC7	MC1408B CMOS Dual 4-Bit Latch
IC8,IC9	4511B CMOS BCD-to-7 Segment Driver
IC10,IC11	74C922 CMOS Keyboard Encoder
ICI2	7805 5V Regulator
LD1,LD2	LT313 8mm Common Cathode LED display
Miscellaneous	
XI	2MHz Crystal
SW1 to SW17	Snap action keyboard switches
SW18	Miniature on/off toggle
SK1	Plug pack connector
SK2	5 Pin Din socket
	any suitable box can be used, eg, Jaycar's Console box as used in the prototype.
	9V 300mA Plug pack.

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Pack 300 E48 1% resistors	R-7015	$17.55	$11.60
7.5k 5W wire wound pot (metric)	R-6923	$6.95	$2.20
Mini Electric Motor	J-1041		$1.50
27k 1W resistor	R-1508	12¢	5¢
8.2k 5W wire wound resistor	R-1708	60¢	5¢
1.8k ½W resistor	R-1280	7¢	5¢
680 ohm 1W res	R-1470	12¢	5¢
500k linear pot imp	R-1812	$1.20	70¢
100k log pot imp	R-1824	$1.20	70¢
20k dual linear pot (imp)	R-1836	$1.20	70¢
100k dual linear pot (imp)	R-1840	$1.20	70¢
10k dual linear pot (imp)	R-1834	$1.20	70¢
10k dual log pot (imp)	R-1849	$1.20	70¢
50k dual log pot (imp)	R-1853	$1.20	.70
1M log switch pot (imp)	R-1888	$2.40	70¢
100k multiturn trimpot	R-1910	$1.25	70¢
50k log pot (imp)	R-1823	$1.30	70¢
2M linear pot (imp)	R-1814	$1.30	70¢
10k log pot (imp)	R-1820	$1.30	70¢
1M linear pot (imp)	R-1813	$1.30	70¢
10k log pot (metric)	R-6820	$1.30	70¢
10k linear pot (imp)	R-1806	$1.20	70¢
20k dual linear pot (metric)	R-6836	$2.85	70¢
1k linear pot (imp)	R-1803	$1.30	$1
0.1 ohm 5W resistor	R-1600	60¢	35¢
100k log pot (metric)	R-6824	$1.30	35¢
50 ohm 3W w/w pot (metric)	R-6907	$3.95	35¢
200 ohm 3W w/w pot (metric)	R-6911	$4.10	35¢
10k 5W w/w pot (metric)	R-6925	$6.95	35¢
2.2M 5mm vertical trimpot	R-1954	55¢	35¢
3.3 ohm 5W w/w resistor	R-1614	60¢	35¢
100k 10mm vertical trimpot	R-1965	55¢	35¢
470k 5mm horizontal trimpot	R-1781	60¢	35¢
10000uF 40V electrolytic	R-4595	$19.95	$10.55
4700uF 35V electrolytic	R-4215	$4.35	$2.10
33uF 10V electrolytic	R-4330	30¢	5¢
22uF 25V electrolytic	R-4319	30¢	5¢
12pF 50V ceramic	R-2237	17¢	5¢
33uF 10V tantalum capacitor	R-4765	95¢	70¢
2uF greencap (100V)	R-2140	$1.90	$1
47uF 350V electrolytic	R-4120	$2.50	$1
2200uF 35V electrolytic	R-4459	$1.35	35¢
1000uF 16V electrolytic	R-4175	$1.05	35¢
2200uF 16V electro (RT)	R-4459	$1.35	35¢
2200uF 16V electrolytic (RB)	R-4196	$1.40	35¢
330uF 25V electro	R-4400	75¢	35¢
4.7uF 25V electrolytic	R-4310	30¢	10¢
47uF 25V electrolytic	R-4350	35¢	10¢
.047uF greencap 100V	R-2080	30¢	10¢
2.2uF 25V electrolytic	R-4300	30¢	10¢
.056uF greencap 100V	R-2085	30¢	10¢
100uF 25V electrolytic	R-4130	45¢	10¢
74C173 IC	Z-5376	$1.50	$1.50
74C922 IC	Z-5380	$3.75	$2.95
4029 IC	Z-5629	$1.95	$1.25
74HC123 IC	Z-5910	$2.75	$1.35
MM5865 timer IC	Z-6816	$4.00	$4.00
74HC373 IC	Z-5965	$1.00	$1.00
74C946 IC	Z-6301	$24.50	$8.95
74LS123 IC	Z-5310	$1.45	$1.00
TBA120T TV sound IF IC	Z-2510	$2.49	$2.49
LM335H temp sensor	Z-6050	$4.45	$2.35
4116 RAM IC	Z-9310	$1.00	$1.00
TLC251 op amp IC	Z-6021	$5.15	$2.35
TBA820M audio IC	Z-2506	$4.45	$2.55
LM394C IC	Z-6083	$7.15	$7.15
74LS244 IC	Z-5294	$2.75	$1.55
74C173 IC	Z-5376	$1.50	$1.50
74193 IC	Z-5280	$2.05	$1.50
74HC244 IC	Z-5950	$3.85	$1.30
76604N IC	Z-6835	$6.53	$2.39
LM3600 IC	Z-6113	$2.75	$1.50
4543 IC	J-1070	$4.50	$4.00
74LS373 IC	Z-5295	$2.75	$1.00
74LS241 IC	Z-5293	$1.00	70¢
7495 IC	Z-5095	$1.00	70¢
7483 IC	Z-5083	$1.40	70¢
4526 IC	Z-5744	80¢	70¢
LM386 IC	Z-6086	$2.50	70¢
74LS73 IC	Z-4973	$1.45	70¢
LM78L12CZ 12V regulator	Z-6110	85¢	70¢
74C221 IC	Z-5378	$2.10	70¢
4044 IC	Z-5644	80¢	70¢
74LS138 IC	Z-5284	75¢	70¢
74LS74 IC	Z-4974	85¢	70¢
LM78L15CZ 15V regulator	Z-6111	85¢	70¢
74157 IC	Z-5267	85¢	70¢
74123 IC	Z-5263	$1.25	70¢
74LS32 IC	Z-4932	85¢	70¢
7414 IC	Z-5024	90¢	70¢
74109 IC	Z-4109	$1.55	70¢
4520 IC	Z-5742	80¢	70¢
74LS175 IC	Z-5291	$1.50	70¢
4024 IC	Z-5624	$1.30	70¢
4528 IC	Z-5748	$2.75	$1.00
74LS373 IC	Z-5295	$2.75	$1.00
4051 IC	Z-5651	$1.95	$1.00
LM308 IC	Z-6045	$1.65	$1.00
4020 IC	Z-5620	$1.65	$1.00
CA3140 IC	Z-5417	$1.95	$1.00
74LS10 IC	Z-4910	85¢	35¢
74LS08 IC	Z-4908	85¢	35¢
74LS14 IC	Z-4914	85¢	35¢
74HC367 IC	Z-5960	80¢	35¢
7401 IC	Z-5011	35¢	35¢
74LS31 IC	Z-4931	55¢	35¢
7410 IC	Z-5020	90¢	35¢
7408 IC	Z-5018	70¢	35¢
74LS06 IC	Z-4900	75¢	35¢
7400 IC	Z-5010	35¢	10¢
7413 IC	Z-5023	50¢	10¢
AD162 Germanium transistor	Z-1112	$2.95	$1.95
AD161 Germanium transistor	Z-1110	$3.45	$1.95
Pack 100 3mm premium red LEDs	Z-4076	$19.95	$14.50
2SC710 RF transistor	Z-2512	$2.95	$1.95
2N4427 RF transistor	Z-2506	$3.99	$2.55
2SC2694 power transistor	Z-2505	$44.95	$31.60
3SK121 GaAsFET	Z-1845	$8.25	$1.80
BF115 RF transistor	Z-1560	$2.45	$1.40
MEL12 photo transistor	Z-1952	$1.25	70¢
BFR91 RF transistor	Z-1691	$3.60	$1.00
2N4427 transistor	Z-5740	50¢	35¢
BF470 trans	Z-1636	$1.50	35¢
2N5480 trans	Z-2340	95¢	35¢
BC549 trans	Z-1329	40¢	10¢
BC337 trans	Z-2190	40¢	10¢
BC338 trans	Z-2252	35¢	10¢
Speaker connection terminal	H-6770	50¢	50¢
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P/B illuminated switch (green)	S-1522	$10.95	$6.85
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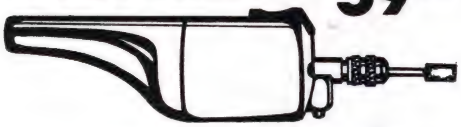

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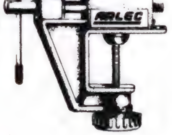

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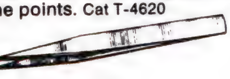

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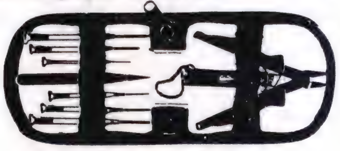
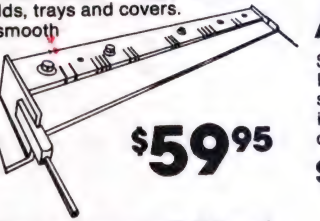


Metal Bender

You can easily make your own with DSE's Sheet Metal Bender. You'll save $$$ making your own heatsinks, RF shields, trays and covers. Provides a clean, smooth bend up to 90° on metals to 16 gauge. Cat T-5250



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- **12-35V DC operated (external)**
- **Chuck sizes 0.4-1.5mm, 1.7-2.9mm & 2.8-2.4mm**

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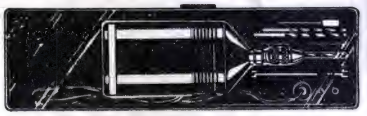

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0.8mm Cat T-4825

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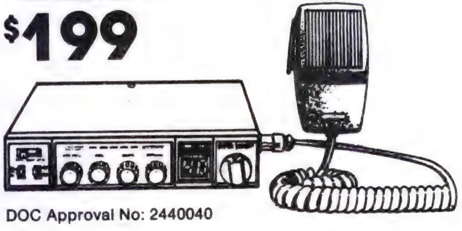
$199



DOC Approval No: 2440040

Light Duty Antenna Base

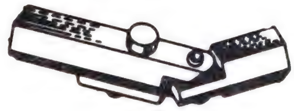
Standard 5/6″ 26TPI threaded mount in black ABS base. Suits ¼ wave and smaller CB antennas or small VHF whips. Mounting plate includes solder lugs for coax connection. Cat D-4056

$3 50

Antenna Layover

Heavy duty unit allows antenna to be left in three separate positions, vertical, horizontal or angled. Positions are easily obtained at the push of a button. Will not layover if hit. Cat D-4506

$8 95



Magna-base Universal Mount

A quality magnetic base — ideal for the company car where holes aren't allowed! Complete with 2m coax and PL-259 plug. Standard thread suits most antennas. Cat D-4514

$34 95

Rubber Duck Antenna

Here's a tiny one...just 33cm long! Helically wound, extremely flexible. Standard 5/16″ base (not supplied). Cat D-4635

$10 95

WIRE

VARIOUS HOOK-UP WIRES

10 x 0.12 (equiv. 10 x .0048) PVC hook up wire for projects, repair, hanging the washing on ...anything!

W-2220	**RED**	W-2227	**PURPLE**
W-2221	**BLACK**	W-2228	**BLUE**
W-2222	**BROWN**	W-2229	**GREY**
W-2223	**ORANGE**	W-2230	**CREAM**
W-2224	**YELLOW**	W-2231	**WHITE**
W-2225	**GREEN**		
W-2226	**BLUE (DARK)**		

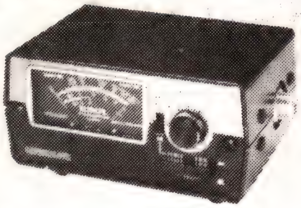
$3.50 PER 100m ROLL

OR 10¢ PER METRE

The Best Test On 2!

The Oskerblock SWR-145 keeps you up to date! Designed to be left 'in-situ' for permanent readings. With a top range on two metres of 250 watts and, for VHF users, it needs very low power for full scale readings!
Cat Q-1341

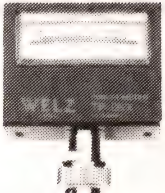
$99



VHF Hand-held Power Meter.

Weltz quality, the ultimate versatility and DSE value! Check the output of your hand-held accurately — just connect the TP-05X in place of your antenna and you've got it! Cat Q-1343

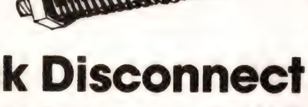
$29



Lightweight Spring

Designed to suit standard loaded ¼ wave mobile whips, to give the type of flexibility required in today's low car parks! Cat D-4500

$7.95



Quick Disconnect

Enables you to remove your antenna from its mount with an easy press and twist. Saves your antenna being stolen. Cat D-4501

$10.95

Budget Priced 3.5 Digit

This just goes to prove that you don't have to spend a fortune on quality test equipment! Pocket sized with easy one hand operation the 3.5 digit wide-angle LCD gives accurate readings at a glance. With overload protection, RF shielding, all ohm ranges handle 250V AC or 350V DC indefinitely and much, much more! Cat Q-1515

- **2, 20, 200, 1000V DC**
- **2, 20, 200, 750V AC**
- **Resistance: 2, 20, 200k, 2M**
- **Robust housing**
- **Much more!**

$69

At last! Frequency reading DMM!

It's finally happened: a digital multimeter with frequency reading...as well as all the advanced features of a top DMM (capacitance, transistors & diodes, continuity, etc). Also features direct frequency readout to 200kHz. Ideal for audio and general service work. And it even reads to 20A AC/DC! Cat Q-1505

- **Frequency to 200kHz**
- **Current to 20A**
- **Transistors, diodes & capacitance too.**
- **AC: 2, 200mA, 20A**
- **Transistors: Hfe**
- **Diodes: Vf**
- **DC: 200uA, 2, 200mA, 20A**
- **Top quality rubber insulated probes/leads included.**

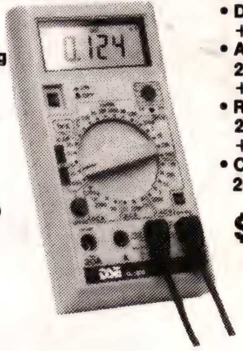
$159

4.5 digit with Data Hold Function

What was the result? With most meters the reading is but a moment in time. If you miss it... The DSE Q-1600 solves the problem: hit the "data hold" button and the reading is frozen on the display! Another highly unusual feature is it's 20A range — double most meters. Add to that transistor and diode checking, capacitance, plus buzzer and LED continuity, and you have one of the most versatile meters ever produced.
Cat Q-1600

- **"Data Hold" function**
- **Up to 20A current reading**
- **Capacitance & transistors too**
- **Resistance: 200, 2k, 20k, 200k, 2M, 20M**
- **Capacitance: 2, 20, 200nF 2, 20uF**
- **Transistor Check: Hfe**
- **Continuity: Buzzer & LED**
- **Top quality rubber insulated leads included**

$225

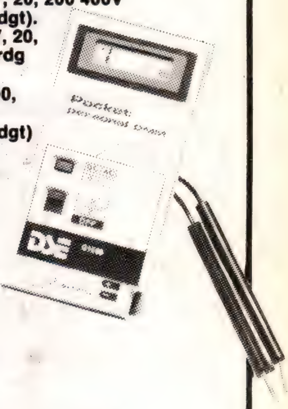


Personal LCD with Auto Ranging

An amazing feature-packed 3.5 digit multimeter that's the size of a pocket calculator: only 10mm thick! Perfect for on-the-spot testing. It may be small but it boasts a number of impressive features. There's super-fast auto ranging, automatic polarity indication, 2 times/second sampling and audible continuity. Can even be used as a milli-volt meter (up to 20KHz).
Cat Q-1555

- **DC Voltage: 2000mV, 20, 200 400V +/−(2.0%rdg +/−2dgt).**
- **AC Voltage: 2000mV, 20, 200 400V +/−(3.0%rdg +/−5dgt).**
- **Resistance: 200, 2000, 20, 200k ohms +/−(2.0%rdg +/−2dgt)**
- **Continuity checks: 200 ohm +/−10ohm**

$49.95



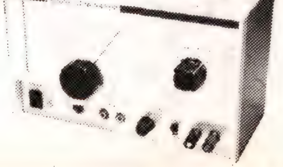
'Pigeon Pair'

AF Signal Generator

Square/Sine wave output audio signal generator, essential for work on huge range of circuits. With wide 20Hz-200kHz output and high accuracy, it is the perfect partner for the Q-1312 RF generator.
Cat Q-1310

- **Frequency range: 20Hz-200kHz**
- **Output control: High/Low unbal. (-20dB) and fine adjuster**
- **Sine wave output: 20Hz-20kHz, 5V rms max at 1% or less distortion**
- **Square wave o/p: 20Hz-20kHz, 10V p-p, 0.5us rise time**

$179



Wideband RF Signal Generator

Low cost RF signal generator that's ideal for the hobbyist/amateur as well as the serviceman. Great for checking tuners in AM, FM, and TV sets plus a huge range of general purpose service, troubleshooting and development work.
Cat Q-1312

- **Frequency range: 100kHz to 150MHz in six overlapping ranges**
- **RF output: 100mV rms approx (up to 35MHz)**
- **Modulation: 1kHz internal, 50Hz-20kHz external**
- **Audio output: 1kHz at 1V rms (fixed)**
- **Crystal oscillator: 1-15MHz external crystal, FR243 holder**

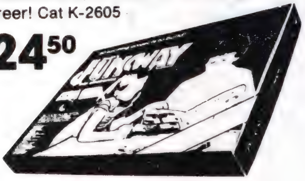
$179

KITS

FunWay 1 Gift Box

Makes an ideal birthday or Christmas present... and who knows, it could be the start of an absorbing lifetime hobby in electronics, or even an exciting career! Cat K-2605

$24.50



FunWay 2 Gift Pack

Here's a gift bargain! Over $35 worth of value for less than $27! This gift pack has been specially selected for quality and for value. Cat K-2620

You get: • A copy of FunWay Volume 2 • A quality DSE Soldering Iron • A pack of solder • A 9 volt battery PLUS: A 'Wireless Microphone' Kit (kit 11) — by far our most popular FunWay kit!

$26.95

FunWay 3 Bonus Pack

And what value! Buy this kit with two of the most popular kits in the FunWay 3 Book... and we throw the book in **FREE!** Yes, you get the Electronic Cricket project plus the Miniature Amplifier project — and as a bonus, the FunWay 3 Book itself at no extra charge!
Cat K-2670

$29.95

FunWay Jumbo Gift Box

This pack isn't called the Jumbo pack for nothing: it's chocka-bloc with over 30 projects and a quality soldering iron to build them all. This may be the best gift a parent can give. Cat K-2690

$98.95

FunWay 1 Project Kit 1-10

Enables you to build any of the first 10 projects in FunWay 1. And because the components are not soldered, they are all reusable so you can build any other of the first 10 projects, too! Cat K-2600

$8.95

FunWay Project Kit 11-20

Contains the more specialised components required to complete the last 10 projects (11-20) in FunWay 1. NOTE: you will also need the 1-10 kits to build these projects. Cat K-2610

$9.95

FunWay 1, 2 & 3 Gift Box

The pack contains all three books and a selection of the most popular and stimulating projects from each. Build a Flashing Brooch, Wireless Microphone, Cricket and Mini Amplifier plus much more! Cat K-2680

$54.95

Binary Bingo

A great school project: it's a fun game — but even more it demonstrates binary numbers very well. And they're the basis of all computers! It seems pretty simple to play... but try it!
Cat K-2668

$7.95

Two Up

Australia's 'national game' has finally been converted to electronics. Simulates the throw, the spin and the final result. Come in spinner! Cat K-2661

$4.95

Soundbender

With this great little kit you can sound like a Dalek, Darth Vader, a Cylon or any one of a dozen robotic spin-offs! A versatile unit, it may also be used for special effects on electric guitars and other musical equipment. Cat K-3509

$37.95

Lamp Saver

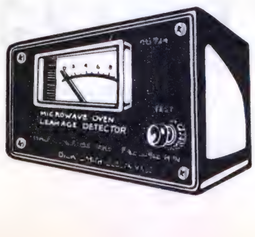
What a great idea! The DSE Lampsaver Kit will greatly extend the life of any 240V AC incandescent lamp. Those expensive Edison-screw spotlamps, etc can cost you a fortune when you have to replace them — but now, Lampsaver is here! The simple, money saving circuitry fits neatly behind your wall switch. Cat K-3083

$14.95

Microwave Leakage Detector

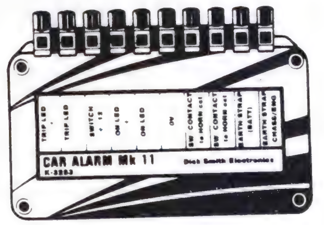
Microwave ovens are fantastic — but are they completely safe? Your's could be leaking dangerous radiation! Check it out with this handy meter. No batteries required. Cat K-3095

$17.45



Car Alarm Mk 2

Includes die-cast case & terminal block



One of the most sophisticated, yet simple alarms around. It uses a triggering technique which makes it less prone to false alarms — yet it will sense a voltage drop anywhere in the electrical system. Cat K-3253

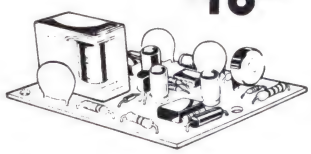
$35.50

Economy Car Alarm

Low cost protection!

This alarm senses the voltage drop in your car's electrical system when a thief breaks into it. There's a visual warning for thieves so that chances are they will not even attempt a break-in. Cat K-3250

$16.95



Ignition Killer

Ingenious but simple circuit based on a 555 timer that literally kills you car ignition. Making the thief think something is wrong with the engine. The theory is he'll then go and pinch someone else's car instead. Cat K-3255

$22.95

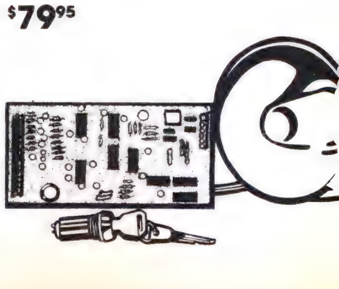
Deluxe Car Alarm

Here's what it offers:

- Two delayed and six instant alarm input
- Delayed entry and exit times (10s each)
- Provision for auxiliary battery
- Siren output (in case vehicle horn is disabled)
- Flashing dash lamp, internal key operated on/off, etc

Cheap insurance for your vehicle!
Cat K-3252

$79.95



Ultra Fidelity Preamp

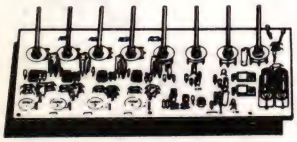
Acoustic performance is its prime aim while, for systems with CD players, it gives a clean signal source, excellent frequency response and superb distortion characteristics! The unit makes it possible for the signal leaving the final low level stage to reach around 20V rms and provides high level inputs for CD, tuner 1 & 2 and aux. Cat K-3037

$29.95

4 Input Mixer Preamp Kit

Great money saver for small bands. Use all four inputs to connect guitars or a mixture: guitar, mic and line inputs. You can select gain and impedance on individual inputs. Features bass, presence, treble tone controls and more!!!! Cat K-3036

$59.95



Graphic Equaliser

Get total control and flexibility with your sound system. With cut and boost of up to 13dB per channel. You can even make equalised tapes. Features professional quality brushed aluminium front panel.

Specifications:

Freq. respons (eq 'IN'): 10Hz to 10KHz +/-.25bd (-1db @20KHz)

Boost and Cut: max 13dB

Steps: 10 in each stereo channel (individually controlled)

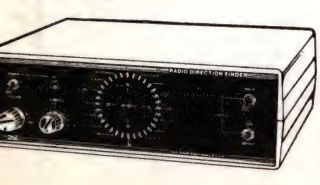
Cat K-3500

$139

Radio Direction Finder

When coupled with a suitable FM receiver it rapidly indicates the direction of the RF signal being received. The system employs an electronically 'rotating' antenna to produce frequency modulation by Doppler shift. 32 LEDs representing the 32 points of the compass, indicate the direction of the received signal. Can be constructed by anyone with an intermediate level of electronics knowledge. Cat K-6345

$149

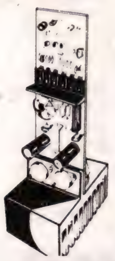


60W Mosfet Amp Module

Improve the performance of your medium power amplifier with this affordable module. Second and third harmonic distortion figures are below 0.001% at full power, and intermodulation distortion is below 0.003% at 10kHz. Frequency response is flat within +/-0.4dB from 8Hz-29kHz. Cat K-3441

$43.95

Includes Heatsinks!



Musicolour Mk IV

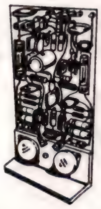
Four chase patterns plus auto chase and reverse chase AND four channel colour organ with built-in microphone! Means you're ready to start a lightshow! Comes with sturdy case and exclusive DSE front panel!Cat K-3143

$135

50W Module

Incredibly reliable — yet very simple to build. The complete amplifier on one pcb — all you do is add a heatsink, connect to power... and go! Perfect for band use, PA, even as half a stereo pair! Cat K-3440

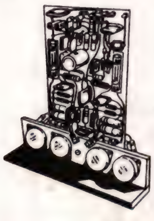
$22.95



100W Module

As for 50W module, but double the output. Use two for stereo, or even use in bridge for double output! (Get up to a massive 200W output!) Sensitivity (1V) and supply (33V @ 2.4A). Cat K-3442

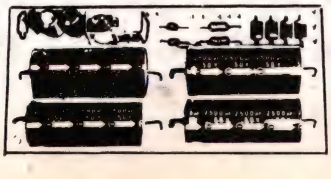
$29.95



Power Supply

Designed to suit either two 50 watt (K-3440) or one 100 watt (K-3442) modules. Includes speaker de-thump circuitry for smooth switching. Amazingly simple to construct and incredibly inexpensive to buy! It doesn't include transformer though. Cat K-3438

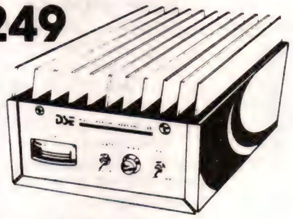
$23.95



100W VHF Linear Amplifier

Cut through the noise and put out a whopping signal with this one. 100W continuous output (in fact, 120W with 15W in!). And from only 2W drive you'll still get a healthy 40W+ out. Uses high quality coax relays for minimum noise and minimum loss. Cat K-6313

$249



2m Amateur Transceiver

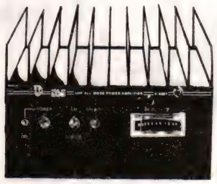
The 'Commander' has specs which more than match most commercial transceivers selling for two or three times the price. It covers the full 144-148MHz band in 10kHz channels (with 5kHz offset), with full repeater facilities built in. And it delivers around 10-15 watts! Cat K-6308

$199

UHF All Mode Power Amplifier

50 watts out from just 2 watts of drive? Sounds too good to be true! 14dB gain with a 10MHz bandwidth — and you can internally adjust the centre frequency anywhere from 430-480MHz! Cat K-6307

$279



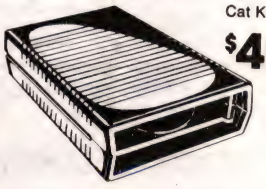
13.8V 2A Power Supply

For the UHF or VHF transceiver

Matching supply for the Explorer UHF or Commander VHF transceivers. Built in the same style, supplies 13.8 volts regulated at 2 amps continuous.

Cat K-6310

$49.95



GaAsFET VHF Preamps

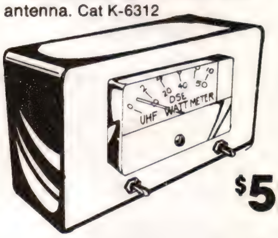
The very latest design featuring the wonder semi-conductor of the eighties: Gallium Arsenide FETs. Giving superb noise figures and high gain.

2 metre (VHF) model: 144-148MHz bandwidth. Ideal for amateur satellite work. Cat K-6311

$89

UHF Wattmeter

Now there's an inexpensive way to check your UHF power output and the efficiency of your antenna system! Here's an easy to assemble wattmeter which not only measures the power output of your transceiver but also has a switch so you can measure the reflected power back from your antenna. Cat K-6312

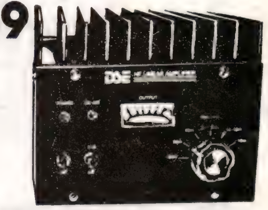


$52.95

100W HF Linear Amplifier

Designed for the HF Transceiver but also perfect for use with a huge range of QRP commercial gear, in the range of 3 to 15 watts output. It gives around 10 to 14dB gain so up to 100W output could be obtained from a very modest input! The circuit is wide band and has only 3dB drop-off at 28MHz. Cat K-6331

$349



1GHz DFM for under $300: complete!

Yes, it's true. A 1GHz digital frequency counter with typical sensitivity of around 20mV — and even more! It's delightfully simple to build! Based on the very latest technology LSI chips, this outstanding design features specifications at least the equal of commercial units costing many times the price. Cat K-3437

$259

HF Amateur Transceiver

An HF Amateur Band Transceiver you can build yourself. The state-of-the-art design can cover any single 500KHz amateur band within 2-30MHz, features CW, LSB & USB transmission modes, and boasts an incredible 30W PEP (SSB) output! Cat K-6330

$299

DICK SMITH ELECTRONICS

KEEPING AMATEURS IN TOUCH!

The Magnificent... Yaesu FRG-9600

All receivers should be built this way — but then, Yaesu know how to build the best! The FRG-9600 is THE all mode VHF/UHF Receiver for the serious minded amateur. Covers the complete 60-905MHz spectrum with manual or fully automatic scanning — the choice is yours! FM, AM, CW, SSB... it's all there. For more features and better value, you can't go past DSE and Yaesu!
Cat D-2825

$1199

General Coverage FRG-8800

With an 8 bit microprocessor controlling all the tuning, mode selection, scanning, memory and clock functions you know the FRG-8800 can give you all the versatility you're ever likely to want. Covers the entire 150kHz-29.999MHz range PLUS it has inbuilt provision for VHF converter. Features 12 internal memories, keypad, dial or automatic tuning, all mode/selectable IF-BW... just about everything a general coverage receiver can have!
Cat D-2820

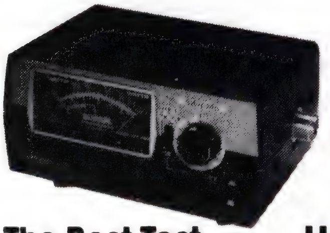
FRG-8800 DC kit Cat D-2822 FREE with purchase of D-2820 — value $8.75

$1259

The Complete Amateur Station

For the amateur who wants everything in a transceiver — Yaesu developed the FT767GX. You want all bands? With 767 — you've got it! From 160 metres to 70 centimetres. Want that again? Yes, 1.8 to 440MHz in one transceiver. You don't know what features are till you've seen the 767 and once you've seen it — you'll own it!
Cat D-2935

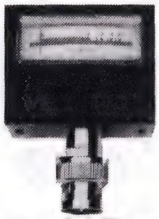
At selected branches only $4995



The Best Test

The Oskerblock SWR-145 keeps you up to date! Designed to be left 'in-situ' for permanent readings. With a top range on two metres of 250 watts and, for VHF users, it needs very low power for full scale readings!
Cat Q-1341

$99



Hand-held Power Meter.

Weltz quality, the ultimate versatility and DSE value! Check the output of your hand-held accurately — just connect the TP-05X in place of your antenna and you've got it! 50-500MHz. Cat Q-1343

FREE with any VHF hand-held set

$29

Simple hands-free operation

Give your FT-2700RH or your FT-270/RH virtual hands-free convenience with the SB-10PTT Switch Unit. Use with optional headset/boom mic etc.
Cat D-3519

$39.95

"We all know that the world's best selling Electronics Kits are from Heathkit..." Jack O'Donnell — M.D. Altronics. Thanks Jack: you're right of course.

Heathkit

The Weather Detector!

The Digital Weather Computer displays everything from wind chill factor to indoor/outdoor temperatures, to wind speed and direction with accurate 16-point compass resolution. It even has microprocessor controlled memory for data storage by date and time! But what's best is; You can build it yourself! Cat G-2000

$995

The best in the land — DSE KITS

UHF 40 Channel Transceiver $249

With the DSE Explorer 70cm needn't be out of your reach! For a fraction of the cost of commercial models you too can be out there on the air waves. It's not a beginners kit — but then it's not a beginners sport!
Cat K-6300

UHF 80 Channel Upgrade $12.95

Add another 40 channels in the band from 439-440MHz to your DSE Explorer. This simple circuit gives the Explorer extended coverage of the UHF FM Amateur Band. Simple and incredibly inexpensive! Cat K-6301

50 watt UHF Power Amp $279

This amazing kit will lift a 2 watt output rig to the 50 watt level! Use it with CW, FM and SSB modes. Features 10MHz bandwidth, harmonics better than -60dB, 12 volt operation for mobile or home use AND DSE value!
Cat K-6307

VHF Amateur Transceiver $199

Save a fortune and get yourself a quality VHF transceiver into the bargain! The DSE Commander covers the full 144-148MHz band in 10kHz channels with 5kHz offset and has full repeater facilities built-in. Comes with everything you need to get it up and running.
Cat K-6308

UHF Gasfet Preamp $89

Give your 70cm a real boost in the reception department! For the 430-480MHz bandwidth you couldn't ask for a better kick in the butt. Ideal for both UHF CB and UHF amateur use! Easy to build and even easier to install.
Cat K-6309

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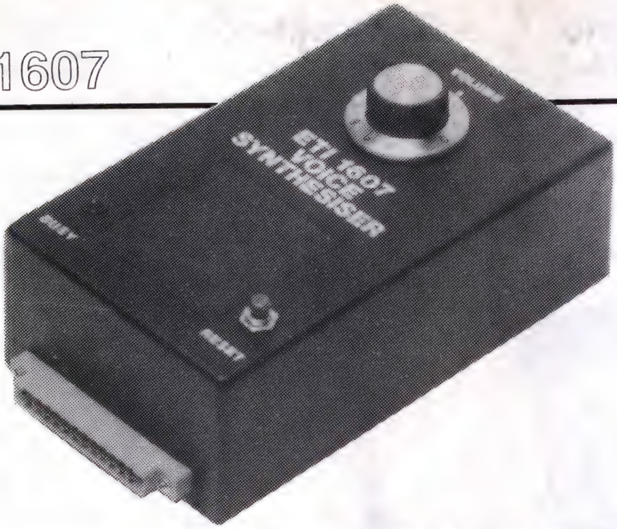
Project 1607



COMMODORE 64 TALKER

This project allows you to create speech using your Commodore 64's user port in conjunction with General Instrument's SPO256-AL2 speech synthesis chip, and a handful of off-the-shelf components.

Vickie & Jeff Rose

SPEECH SYNTHESIZER TECHNOLOGY is by no means new. Speech synthesizers have been in existence for several years now, but until recently, were far too costly for the average experimenter or hobbyist.

There are a number of different types of speech synthesiser chips to select from, some with pre-stored words in their memories where you actually access the 'words', others with which you can make words up from pre-stored portions of speech called 'allophones'. When added together allophones can produce speech in the form of sentences. The limit to the amount of words that can be programmed is virtually endless, a point we will discuss later on.

The design criterion for this project was to produce an inexpensive way to hook up a stand-alone synthesiser with a minimum component count. It was to be powered by the C64's 5 V rails giving a reasonable adjustable speech level along with a design that was simple to assemble and build up.

For the clock, a crystal was not justified since it was desirable to adjust the speech speed in order to listen to the actual words being spoken. A high speed quad NAND gate (74LS00) was chosen to perform the adjustment to the 3.12 MHz clock pulse at OSC1 of the SPO 256-AL2 chip. The output of the speech chip is filtered via a low pass filter, then amplified by a low voltage audio power amp (the LM386) with its gain set at about 200. This then drives a small 8 ohm speaker and all is housed in a convenient black box, complete with the 24-way user port edge connector. The only Sydney source of this is a company called Xenitek, which can be found at 10 Wattle Rd, Brookvale NSW, (02) 938-4311. Since the SPO256-AL2 chip is expensive, it is necessary to utilize a 28-pin DIL socket to accommodate your investment.

Construction

Construction should always commence with the careful inspection of your printed circuit board for any miniscule cracks or spurs of copper giving rise to shorts between adjacent tracks. When you are satisfied that all is well, commence by inserting all resistors in their respective holes, followed by the IC3, the two trim pots, and the capacitors paying attention to the polarity of the tantalums and electros.

The next step is to carefully insert the 28-pin DIL socket followed by the careful insertion of IC1. Observe CMOS handling procedures at all stages when inserting both IC1 and IC2.

After your board is assembled, take time out and re-check that everything is in its right place, that the board is fully assembled, wired and soldered. Clean off the residue flux with either metho or thinners and a brush, then inspect your work for any dry joints (who me?).

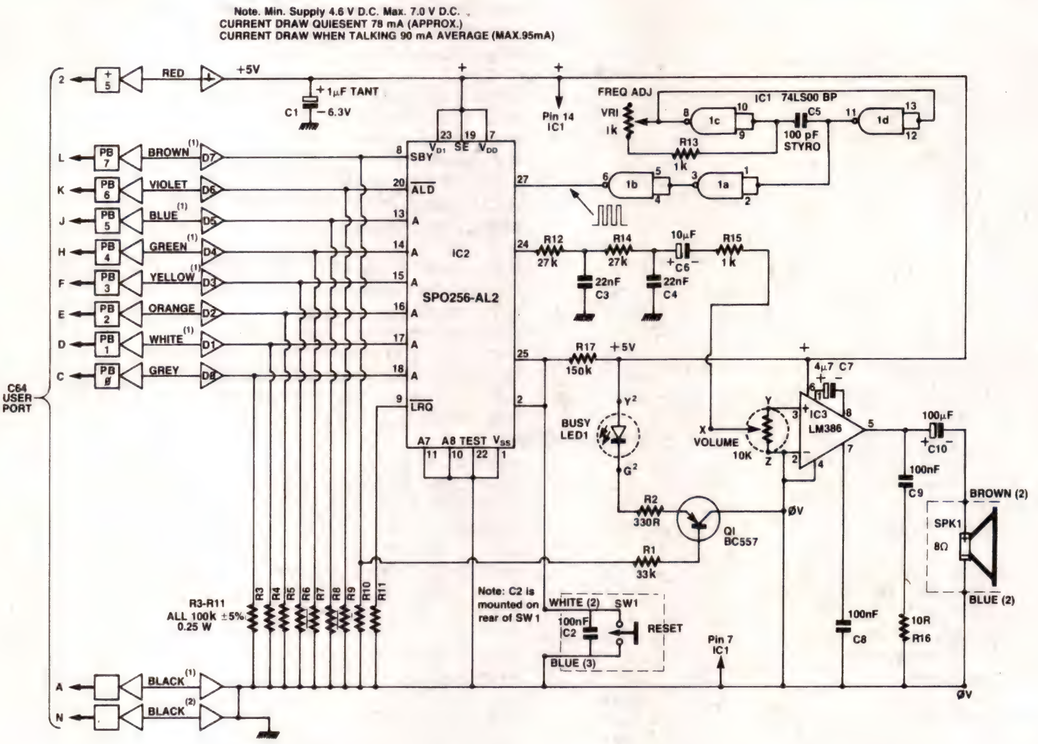
In order to make good connection with the user port, it is necessary that the 24-way connector glides into position with no stress or weight placed upon the C64's port. The rubber feet chosen for your box will determine the size of the cut-out required to successfully mount the 24-way connector. After a bit of experimentation it was found that a 14 mm x 68 mm cut-out was needed to facilitate the mounting and adjustment of the connector so as to allow the connector to easily glide into place. Only the second terminal, +5 volts, is required from the top 12 terminals. The other 11 can be cut off neatly. Cut out a small 90 mm x 17 mm strip of pcb with a 55 mm x 8 mm cut-out to affix the 24-way connector into place with two suitable screws/nuts to secure it firmly.

Scribe the speaker inside and drill a series of 2 mm holes to allow the sound out, then stick it into place with a contact adhesive. Wires can then be added to the LED speaker and reset switch. Capacitor C2 is mounted across the rear of SW1 and not on the pcb.

Next, carefully wire the 10 coloured wires to the rear of the 24-way connector, and after checking your work carefully, assemble the connector into place in the box. With the rubber feet mounted, align the connector with the user port so it glides into place with no effort then remove carefully and tighten both screws firmly. Place a touch of contact adhesive so as to lock the screws in place. Affix the aluminium base plate and tighten the four screws, and the unit is ready to test.

Testing

First you must enter the sample program. BASIC was chosen as it was the simplest way to demonstrate the speech and the allophones. We stress that the speech is slower in BASIC, and it does suffer the problem of an American accent crossed with a former Premier (whoops!).



After loading the program save it and turn off the C64. Gently glide the Talker into the user port and turn your computer back on. Load the program and list it on the screen. Check that it corresponds to the published program. If so RUN it. It will say: "This is an ETI talking chip project" on a green screen; then the program will repeat itself due to loop.

To alter line 58010, type READ W:IF W = 255 THEN STOP: REM SET ALD AND SEND DATA TO PORTS. This will stop it!

Now more on these allophones. Allophones are portions of speech broken down to minimal meaningful sound units. Take a simple word such as 'computer'. This is read in BASIC as DATA 42, 15, 0, 16, 9, 49, 22, 13, 0, 52.

42 = C as in can't;
15 = U as in sUcceed;
0 = 10 ms pause;
16 = M as in Milk;
9 = P as in Pow;
49 = Y as in Yes or Uni;
22 = O as in tO;
13 = T as in To or Tin;
0 = 10 ms pause;
52 = ER as in furr;

Rule number 1: all that sounds is not as it is spelt, as in the case of 'OM' in computer; replace 15 with 24 and notice the odd difference. You can alter the total pronunciation of English by adding pauses or doubling certain allophones.

A breakdown of the programmed text:

Line 58025 DATA 54, 12, 55, 55, 55 = THIS. 12, 43, 55 = IS. 20 = A. Note* 0, 1, 2, 3, 4 are pauses.

Line 58035 DATA 19, 3, 13, 19, 3, 6 = ETI. 13, 23, 23, 1, 42, 3, 12, 44 = TALKING and pause 50, 1, 12, 12, 1, 9, 4 = CHIP and pauses.

Line 58045 DATA 9, 39, 53, 0, 10, 7, 7, 41, 17, 4 = PROJECT. 255 relates to 58010 loop.

You can see the potential of word struc- ▶

HOW IT WORKS

The circuit is basically divided into three set functions. Firstly and most importantly is the oscillator, consisting of 74LS00BP quad, two input NAND gates utilized as inverters and coupled with a 100 pF styrene capacitor in an oscillator configuration. The frequency is determined by RV1, a 1k pot, and a 1k resistor to prevent over frequency adjustment past 3.2 MHz.

One half of IC1 is utilized as the oscillator, the second half as inverter and buffers. This is then fed directly to pin 27 (OSC1) of the SPO256-AL2 chip.

The heart of the project is the amazing speech chip IC2, which is connected directly to the C64's user port via a standard 8-bit parallel port designated D0-D7. This is done by POKE 56579, 127 setting the DDRB, bits 1-7 as outputs and bit 8 as an input. Setting up the ALD and sending data to ports is done in line 58011 POKE 56577, 255: POKE 56577, W.

All connections to the speech chip are protected by 100k resistors as is the LRQ (LOAD REQUEST). Both A7 and A8 are not used hence they are grounded also.

D7 (SBY) is used in conjunction with a pnp transistor Q1 (BC557) so when low signals are received on D7 an LED illuminates, indicating that the data from the C64 is currently being processed by the SPO256-AL2 speech synthesiser.

Pin 22 TEST is grounded as per data sheet. Pin 2 and pin 25 are both held high via R12. C2 provides the low reset pulse when powering up the device. Should the reset (pins 2 and 25) fail to reset correctly, switch 1 is provided to override the auto reset feature. Alternatively, it could be used if you were to hit RUN/STOP before the speech chip had completed reading data and completed speaking.

Pin 24 provides a pulse width modulated audio output that is filtered slightly before being amplified via pin 3 of IC3 (LM386). IC3's gain is set at approximately 200 by C7, but can be varied from a set minimum of 20 upwards to 200 (range 26-46 dBmax). RV2 serves to limit the input to IC3 giving a volume control. The output to the speaker is decoupled via C10 from output pin 5.

GENERAL INSTRUMENTS' SPO256-AL2

Silence

PA1 (10 ms)	before BB, DD, GG, and JH
PA2 (30 ms)	before BB, DD, GG, and JH
PA3 (50 ms)	before PP, TT, KK, and CH, and between words
PA4 (100 ms)	between clauses and sentences
PA5 (200 ms)	between clauses and sentences

Short Vowels

*/IH/	sitting, stranded
*/EH/	extent, gentlemen
*/AE/	extract, acting
*/UH/	cookie, full
*/AO/	talking, song
*/AX/	lapel, instruct
*/AA/	pottery, cotton

Long Vowels

/IY/	treat, people, penny
/EY/	great, statement, tray
/AY/	kite, sky, mighty
/OY/	noise, toy, voice
/UW1/	after clusters with YY: computer
/UW2/	in monosyllabic words: two, food
/OW/	zone, close, snow
/AW/	sound, mouse, down
/EL/	little, angle, gentlemen

R-colored Vowels

/ER1/	letter, furniture, interrupt
/ER2/	monosyllables: bird, fern, burn
/OR/	fortune, adorn, store
/AR/	farm, alarm, garment
/YR/	hear, earring, irresponsible
/XR/	hair, declare, stare

Resonants

/WW/	we, warrant, linguist
/RR1/	initial position: read, write, x-ray
/RR2/	initial clusters: brown, crane, grease
/LL/	like, hello, steel
/YY1/	clusters: cute, beauty, computer
/YY2/	initial position: yes, yarn, yo-yo

Voiced Fricatives

/VV/	vest, prove even
/CH1/	word-initial position: this, then, they
/CH2	word-final and between vowels: bathe, bathing
/ZZ/	zoo, phase
/ZH/	beige, pleasure

Voiceless Fricatives

*/FF */TH/ */SS/	These may be doubled for initial position and singly in final position
/SH/	shirt, leash, nation
/HH1/	before front vowels: YR, IY, IH, EY, EH, XR, AE
/HH2/	before back vowels: UW, UH, OW, OY, AO, OR, AR
/WH/	white, whim, twenty

Voiced Stops

/BB1/	final position: rib; between vowels: fibber; in clusters: bleed, brown
/BB2/	initial position before a vowel: beast
/DD1/	final position: played, end
/DD2/	initial position: down; clusters: drain
/GG1/	before high front vowels: YR, IY, IH, EY, EH, XR
/GG2/	before high back vowels; UW, UH, OW, OY, AX; and clusters: green, glue
/GG3/	before low vowels: AE, AW, AY, AR, AA, AO, OR, ER; and medial clusters: anger; and final position: peg

Voiceless Stops

/PP/	pleasure, ample, trip
/TT1/	final clusters before SS: tests, its
/TT2/	all other positions: test, street
/KK1/	before front vowels: YR, IY, IH, EY, EH, XR, AY, AE, ER, AX; initial clusters: cute, clown, scream
/KK2/	final position: speak; final clusters: task
/KK3/	before back vowels: UW, UH, OW, OY, OR, AR, AO; initial clusters: crane, quick, clown, scream

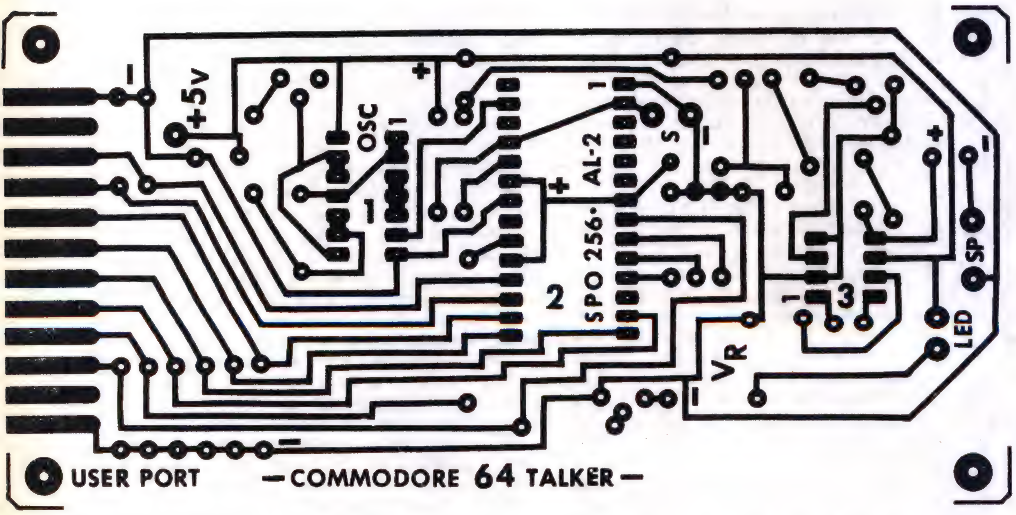
Affricates

/CH/	church, feature
/JH/	judge, injure

Nasal

/MM/	milk, alarm, ample
/NM1/	before front and central vowels: YR, IY, IH, EY, EH, XR, AE, ER, AX, AW, AY, UW; final clusters: earn
/NN2/	before back vowels: UH, OW, OY, OR, AR, AA
/NG/	string, anger

*These allophones can be doubled.



We apologize for not including a front panel layout. We cheated this month and Letraset directly on to the front panel.

ETI-1607 — PARTS LIST

Resistors ..... all ¼ W, 5%

R1	33k
R2	330R
R3-11	100k
R13, 15	1k
R12	10k
R14	27k
R16	10R
R17	150k
RV1	1k Bournes type or sim
RV2	10k Bournes type or sim

Capacitors

C1	1µ tant 6.3 V
C2, 8, 9	100n greencap
C3, 4	22n greencap
C5	100p styro
C6, 7	100µ electro 10 V
C10	100µ electro 10 V

Semiconductors

Q1	BC557 or sim
LED1	red LED & bezel
IC1	74LS00BP
IC2	SPO256-AL2 Tandy or Daneva
IC3	LM386

Miscellaneous

ETI-1607 pcb; UB1 (Dick Smith H-2851) box; variety of coloured hookup wire; 28-way IC socket; small 8 ohm speaker; 6 x 6BA 20 mm long screws and nuts; 4 x stand offs; 1 x 24-way connector (in Sydney from Xenitek P/L part No. 307-024-500-202, Phone (02) 938-4311 or (03) 419-6377 Melbourne); 1 x N/O simple push button switch.

Price estimate: $42

tures that can be created, even with your own accent if you wish. The experimental potential is endless. You may even add speech to your games to give them that extra interaction at certain times.

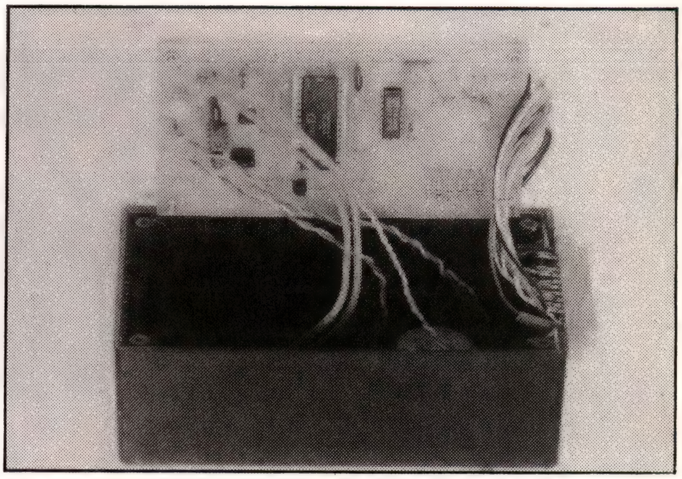
The key to unravelling the spoken word is to say it slowly, then look up the data sheet and write the sounds you think the word is composed of. Proceed using your word as the building block, altering and modifying it as you go, remembering that there are varying pauses in speech.

Note: The SPO256-AL2 from Tandy Electronics Cat No 276-1784 comes complete with a 20-page reference manual and data on the chip. ●

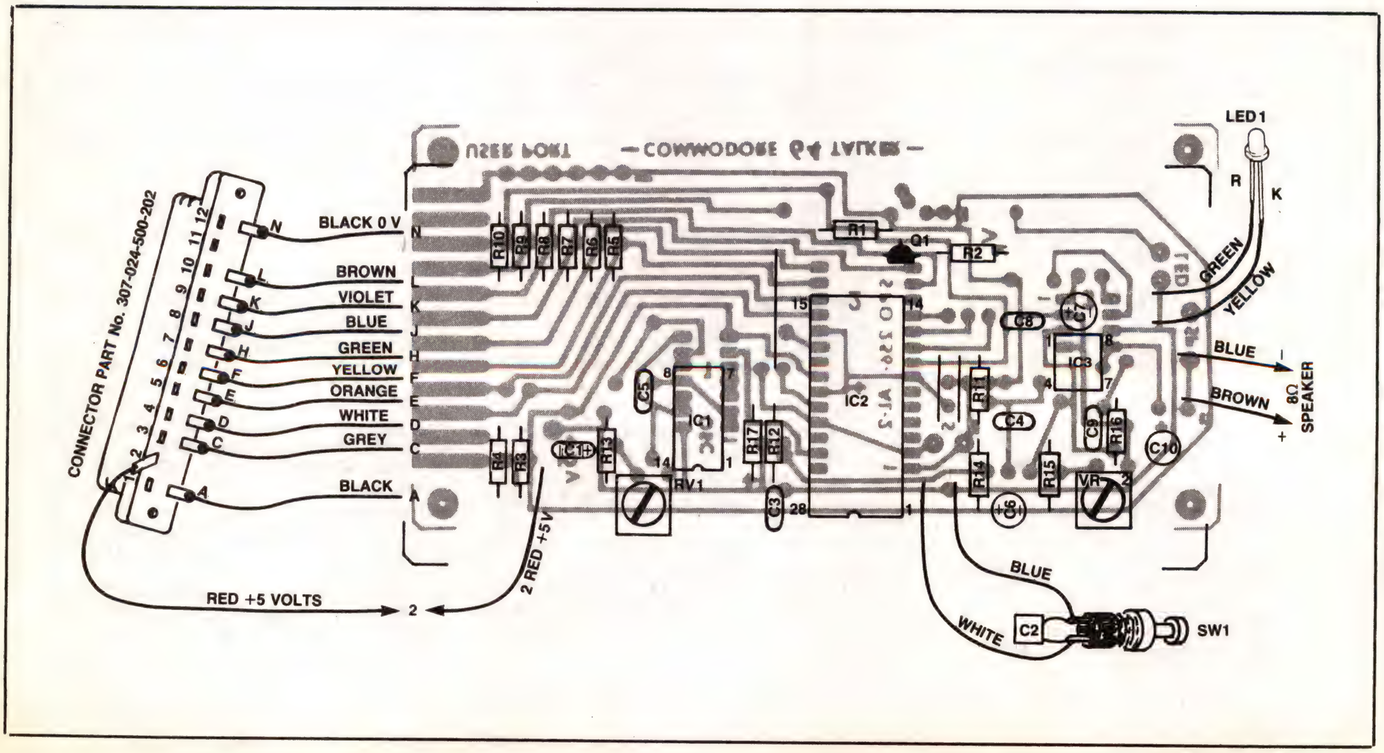
DEC. Address.	OCT.Address	HEX.Address.	ALLOPHONES.	SAMPLE WORD	DURATION
0	000	0	PA1	Pause	10MS
1	001	1	PA2	Pause	30MS
2	002	2	PA3	Pause	50MS
3	003	3	PA4	Pause	100MS
4	004	4	PA5	Pause	200MS
5	005	5	/OY/	OY in bOY	420MS
6	006	6	/AY/	Y in skY	250MS
7	007	7	/EH/	E in End	70MS
8	010	8	/KK3/	C in Comb	120MS
9	011	9	/PP/	P in Pow	210MS
10	012	A	/JH/	G in dodGe	140MS
11	013	B	/NN1/	N in ThiN	140MS
12	014	C	/IH/	I in sIt	70MS
13	015	D	/TT2/	T in To	140MS
14	016	E	/RR1/	R in RuRal	170MS
15	017	F	/AX/	U in sUcceed	70MS
16	020	10	/MM/	M in Milk	180MS
17	021	11	/TT1/	T in parT	100MS
18	022	12	/DH1/	TH in THey	290MS
19	023	13	/IY/	E in sEE	250MS
20	024	14	/EY/	EI in bEIge	280MS
21	025	15	/DD/	LD in couLD	70MS
22	026	16	/UW1/	O in tO	100MS
23	027	17	/AO/	AU in Aught	100MS
24	030	18	/AA/	O in hOt	100MS
25	031	19	/YY2/	YE in YEs	180MS
26	032	1A	/AE/	A in hAt	120MS
27	033	1B	/HH1/	H in He	130MS
28	034	1C	/BB/	BU in BUsiness	80MS
29	035	1D	/TH/	TH in THin	180MS
30	036	1E	/UH/	OO in bOOk	100MS
31	037	1F	/UW2/	OO in fOOd	260MS
32	040	20	/AW/	OU in OUt	370MS
33	041	21	/DD2/	D in Do	160MS
34	042	22	/GG3/	G in wiG	140MS
35	043	23	/VV/	V in Vest	190MS
36	044	24	/GG1/	GU in GUest	80MS
37	045	25	/SH/	S in Ship	160MS
38	046	26	/ZH/	Z in aZure	190MS
39	047	27	/RR2/	R in bRain	120MS
40	050	28	/FF/	F in Food	150MS
41	051	29	/KK2/	K in sKy	190MS
42	052	2A	/KK1/	C in Can't	160MS
43	053	2B	/ZZ/	Z in Zoo	210MS
44	054	2C	/NG/	N in aNchor	220MS
45	055	2D	/LL/	L in Lake	110MS
46	056	2E	/WW/	W in Wool	180MS
47	057	2F	/XR/	R in Repair	360MS
48	060	30	/WH/	W in Whig	200MS
49	061	31	/YY1/	Y in Yes	130MS
50	062	32	/CH/	C in Church	190MS
51	063	33	/ER1/	IR in fIR	160MS
52	064	34	/ER2/	ERR in fIRR	300MS
53	065	35	/OW/	Au in beAU	240MS
54	066	36	/DH2/	TH in THey	240MS
55	067	37	/SS/	S in veSt	90MS
56	070	38	/NN2/	N in No	190MS
57	071	39	/HH2/	H in Hoe	180MS
58	072	3A	/OR/	OR in stORe	330MS
59	073	3B	/AR/	A in alArm	290MS
60	074	3C	/YR/	R in cleaR	350MS
61	075	3D	/GG2/	G in Got	40MS
62	076	3E	/EL/	L in saddLe	190MS
63	077	3F	/BB2/	B in Busy	50MS
DEC. Address.	OCT.Address	HEX.Address.	ALLOPHONES.	SAMPLE WORD	DURATION

GUIDELINES FOR USING THE ALLOPHONES.

```
58001 REM E.T.I.TALKING CHIP FOR C=64.
58003 REM:GREEN SCREEN/BLACK LETTERING.
58004 POKE53280,5:POKE53281,5:PRINT"■"
58005 REM SETTING UP OF D.D.R.B.PB0-PB7
58006 REM THE 1ST 7 BITS ARE INPUTS.**
58007 REM BIT 8 IS SET AS AN OUTPUT.**
58009 POKE56579,127:REM**
58010 READ W:IF W=255 THEN 58055:REM SETA.L.D. AND SEND DATA TO PORTS.
58011 POKE 56577,255:POKE56577,W
58012 REM:CHECK BIT # 8 FOR BUSY FROM SP0256-AL2 SPEECH SYNTHESISER CHIP
58013 Z=PEEK(56577):Z=(Z AND 128)
58015 IFZ<>128 THEN58013
58017 GOTO58010  :REM ALLOPHONE DATA**
58025 DATA54,12,55,55,4,4,12,43,55,4,3,20,4,4
58035 DATA19,3,13,19,3,6,4,4,4,4,13,23,23,1,42,3,12,44,4,50,1,12,12,1,9,4
58045 DATA9,39,53,3,10,7,7,41,17,4,4,4,4,4,4,4,4,4,255
58055 PRINT"■]":
58065 PRINT"■■■■■■■THIS■■IS■■A■■E.T.I.,■■■■■TALKING■■CHIP■■PROJECT.■■":RUN:
```



Inside the box.



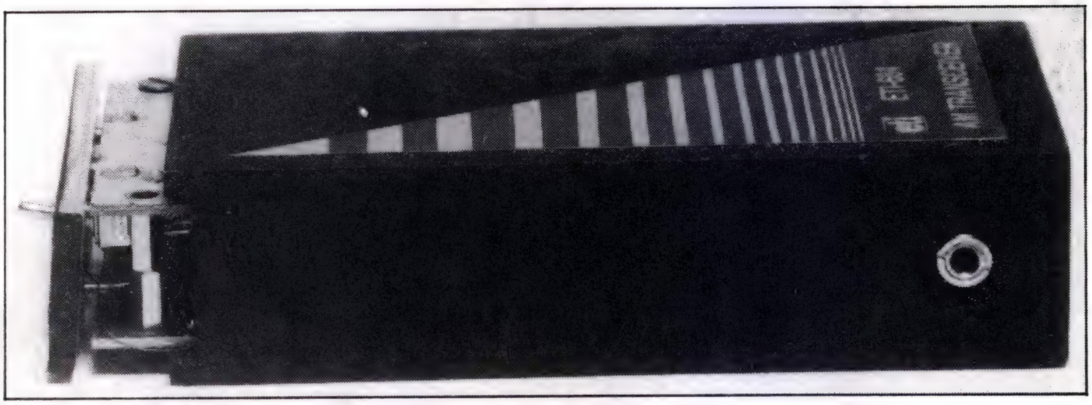
Project 746

27 MHz TRANSCEIVER

Part 2

This month we finish showing you how to build ETI's terribly, terrific transcendental, transceiver.

S. K. Hui



Construction Transmitter

SINCE THE CONSTRUCTION of the box was explained last time, here I will concentrate on assembling the board. First check the parts list to make sure you have the correct components. There should be two different pc boards in your kit; the transmitter and receiver boards. Start with the transmitter, since it will be needed when you test the receiver board.

Once again, you will either love or hate my way of designing the pc boards. I believe that my designs make assembling the boards easier and cheaper. I have deliberately arranged to have the tracks on the component side of the board and used the bottom side as an earthed ground plane. This arrangement provides a solid ground plane and the least number of holes on the board. This reduces the cost of the board to minimum.

On the transmitter board, the first components to be assembled are the transistors. Most of them have their pins cut short and soldered directly onto the board, except the emitter of Q2, which goes through the board and is soldered in the conventional way. As a general rule, when you see a dot hanging off a pin of a component on the overlay diagram, that pin goes through the board. A black dot sitting on top of a donut means a feed-through wire is needed at that point.

Be very careful to make sure none of the transistors' pins are bridged as the spacing between them gets very small after the pins are cut short. The easy one is Q5 though care must be taken to ensure the polarity is correct when being soldered. Figure 1 shows the pin arrangement of Q5 and Q6. They are dual gate MOSFETs housed in a 'button' shape SOT-103 package.

Resistors and diodes can be soldered now but don't forget that some of them have their pins through the board.

Capacitors are soldered as before except that C14 should lie flat to keep the board profile low. Be sure to study the photograph carefully and compare it with the component you are about to solder. Solder in the crystal. Be sure to keep it clear of the surrounding tracks. Integrated circuit IC1 is put on next. All pins of the IC

Specifications

SUPPLY VOLTAGE TO AM transceiver: +12V

1. Unit standby current consumption: 70 mA.
2. Frequency Response (−3d B point)
    (a) Transmitter: 100 Hz-100 kHz
    (b) Receiver: 100 Hz-3.5 kHz.
3. Distortion Figure: 2.6% at 1 kHz modulating frequency with 30% modulating depth.
4. Signal to noise ratio: 40 dB (at 1 kHz modulating frequency).

Conditions in which testing (3) and (4) were carried out are; Modulating signal (sine) at 1 kHz is injected into the mic socket with an amplitude to produce 30% modulation depth. The output signal to be examined is tapped out from the phone socket in the other unit. Two units are separated by 500 mm with no antennas plugged into the antenna socket (SK3). But the socket is connected to the pc boards through two pieces of wire 120mm in length each. In testing (4), the noise refers to the noise received with the modulating signal in the transmitter turned off and the carrier turned on by disabling the voice operated switch.

5. Microphone input is designed to take 600 ohm impedance microphone. Phono output will drive any standard headphone.
6. Operating range (width 9V battery).

Test Condition: One meter antennas, 9V voltage on open field, With antennas held up.

Signals start to fade out at around 550 meters.

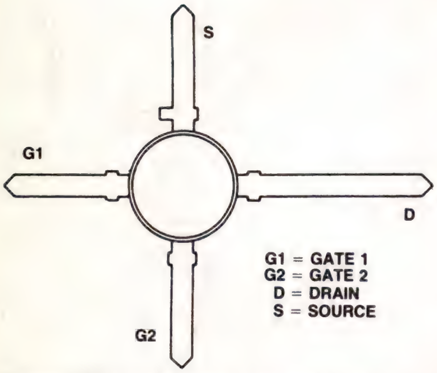


Figure 1: Pin arrangement of BF 981 (sot-103) transistor.

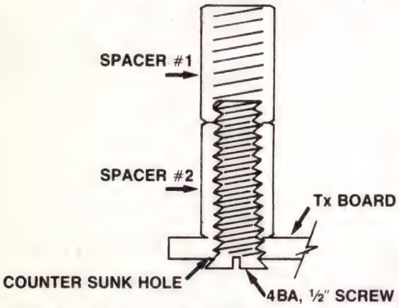


Figure 2. How to mount spacers on transmitter board.

should be cut flat except pin 4, which goes through the board.

The last few components to be mounted are the ones sitting on the front edge of the board like LED1, RV1, 2 and SK1. The way you bend the pin of LED1 or RV1, or the exact spot you solder SK1 will have to match up with the mounting holes on the front panel of the box. Notice that you still have not mounted the coil L1. Leave it for the time being and concentrate on the receiver board.

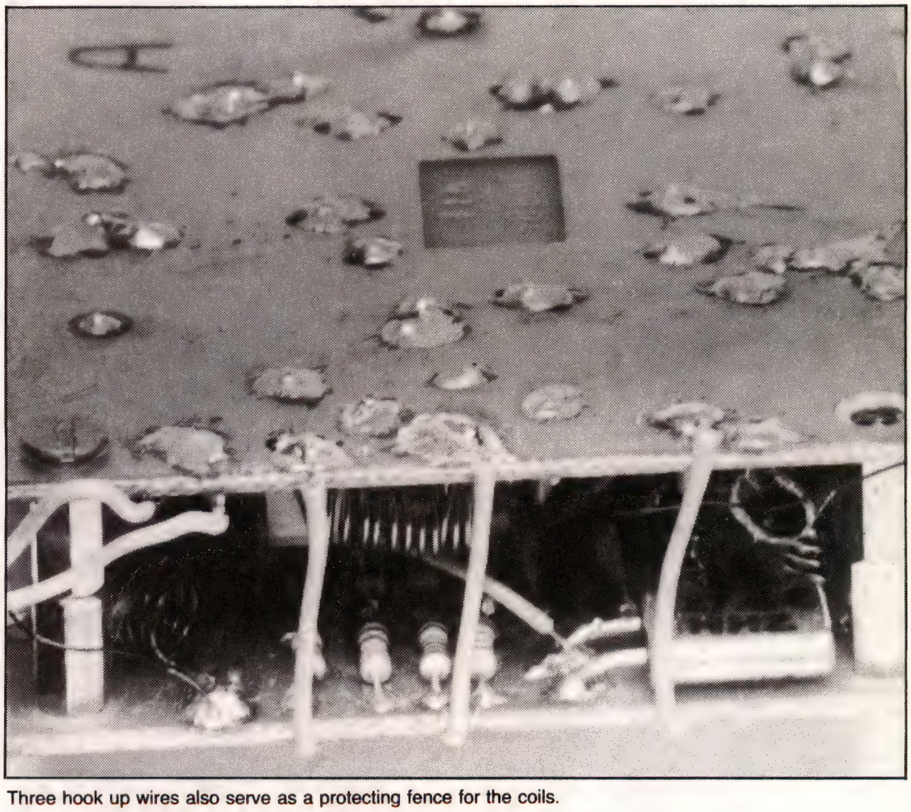
Receiver

The construction of the receiver board is similar to the transmitter board despite a few odd components. Once again, we leave the coil construction to the last. First load the transistors, then the resistors and diodes. Watch the polarity of the diodes. Before you start to solder the capacitors, you must load the ceramic filter (CFW455E) and the RF transformer T1. Their pin arrangement is shown in figure 3. Pin 2, 3, 4 of the CFW455E should be soldered on the bottom of the board. Pin 1 and 5 have to be bent about half way along their length to make a foot for soldering to. Transformer T1 has three pins on its primary side which should face toward C33. You should cut the centre pin short as it is not required when bending the other pins be careful to keep them clear of the case, and be careful of shorting the case on the surrounding tracks. The power on/off switch Sw1 is a small DPDT toggle, pc board mounting type from Dick Smith Electronics. I tried unsuccessfully to obtain the same one from other places. The switch has six pins for electrical connections and one for mechanical strengthening when mounted on board. Referring to the overlay diagram, they are labelled as P1, P2 to P7. Only pin 6 and pin 7 have to be soldered onto the other side of the board. Pin 1 to 5 should be tailored so that they are just long enough to touch the soldering pads when the switch is on the board.

Setting up the unit

At this stage we have no coils on the boards, no power and a problem. There are no reliable 27 MHz transmitters around, so we have no way of knowing when the receiver is set to preceisely 27 Mhz. Without a reliable receiver, we can't set up the transmitter. Is this the end of all our dreams? Not at all.

The first thing to do is to apply power to both boards. The battery and the on/off switch are all located on the receiver board. Check the transmitter and the receiver overlay diagrams carefully, and find the spots labelled as A, B, C. These should be joined together with thin hook up wires. Label A brings the rail from receiver to the transmitter board. ▶



Three hook up wires also serve as a protecting fence for the coils.

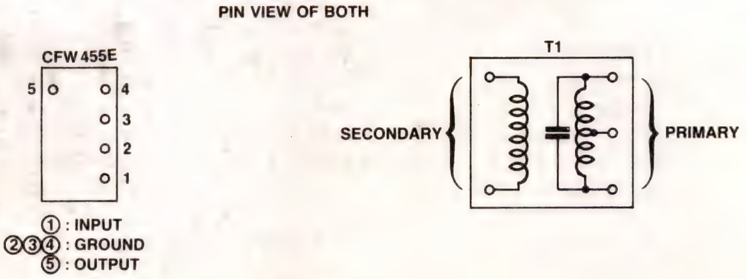
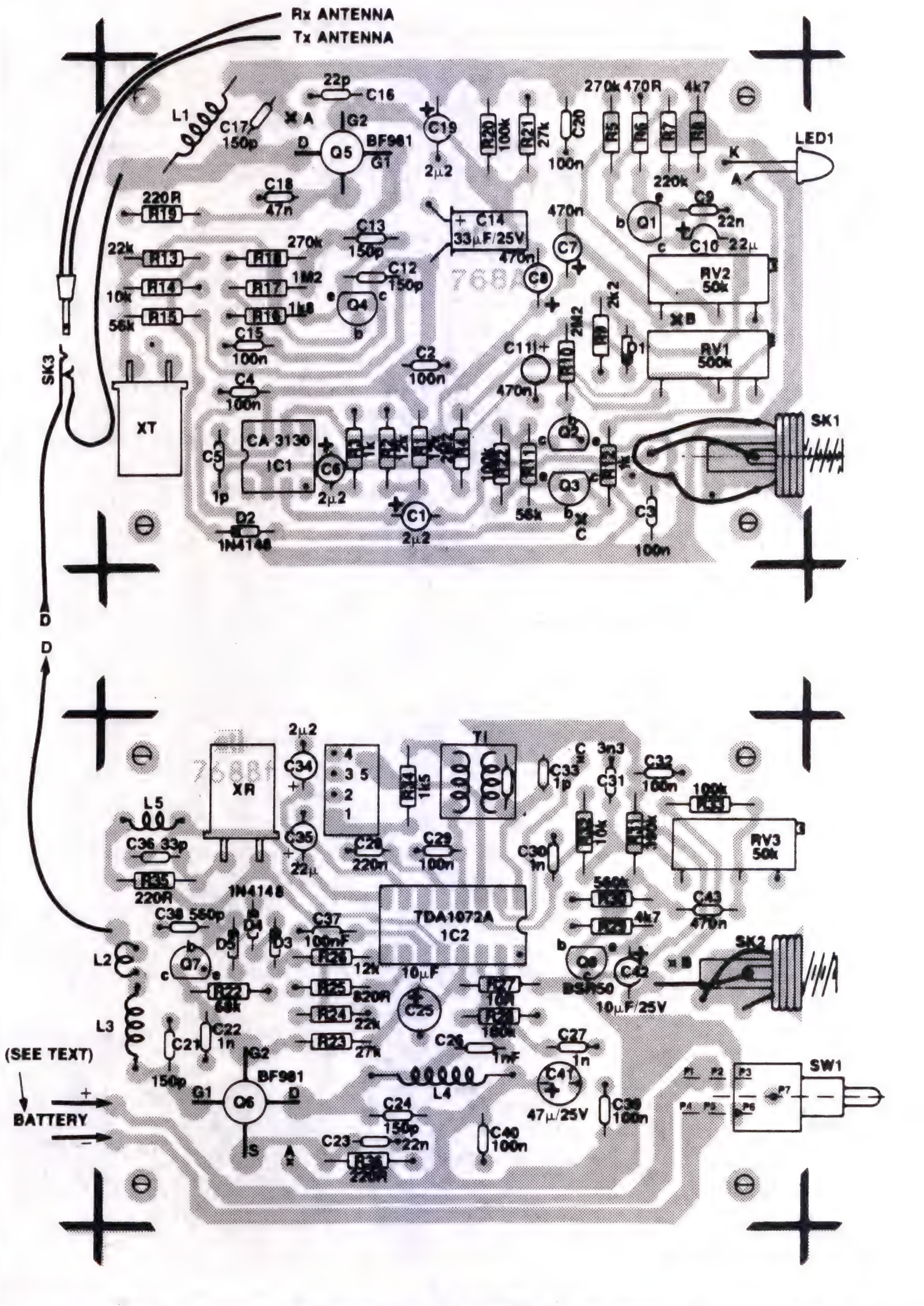


Figure 3. Pin arrangement of CFW455E and T1.



Label B brings the audio output from the op-amp to the headphone driver Q8 so you can hear yourself when you transmit. Label C brings the voice operated switch output to IC2 and disables the receiving chip. Label D on the overlay diagram has no physical meaning. It merely indicates the continuation of the wire from the receiver board antenna port to the socket.

Earth Connections

There are three connections between the two boards but no earth. Although the metal standoffs can be treated as earth connections between the two boards, it is not very reliable. I decided to use dedicated wires for the job. Not only do they make a good connection, they also serve as a protective fence for coils L2, L3 against the battery when the boards are lowered into the box.

Tuning circuit

Now we are ready to begin work tuning the coil. If you look at the box on Coil Construction, you will get a good idea of how this should be done. With the coils soldered into place we are ready to start. The technique is quite simple. We have developed a small tuning circuit that, when applied to your multimeter will give you maximum output when the receiver is turned to 27 MHz.

Since the correct tuning coincides with the maximum amplitude of carrier across the coil, the trick is quite obvious: simply rectify the carrier signal and smooth it out to dc voltage so it can be measured by your multi-meter.

The tuning circuit is shown in figure 4. If you wish you can mount it on vero board or some equivalent. I suggest you simply birdsnest it together. It's only temporary, after all.

Tuning Procedure

The tuning mechanism is the same for all coils. However, each individual coil requires its unique tuning condition to be set up. So here they will be dealt with individually. The tools you need to tune coils include a multi-meter, the tuning circuit, a long 6 BA brass screw and a ferrite slug.

Coil L1

This is the only coil used in the transmitter board. Its function is to form a resonating circuit with the antenna and C17. To tune it properly, a unique antenna has to be selected first. There are two antennas, one for transmitting and one for receiving. The trade-off in picking the right antenna length is a long one for further operating range versus a shorter one for convenience and mobility. My suggestion is one meter long for both. The advantage is you can check your unit against my published information since I used a one meter antenna myself during the testing.

Solder your two antennas into a 2.5mm phono jack and plug it into the SK3 socket. Bear in mind that the SK3 socket is connected to the antenna ports on the transmitter/receiver pc board via two thin insulated hook up wires. Normal hook up wire can be used for the antennas. Separate the two antennas in to a 'V' shape and maintain the shape with cello/masking tape during the tuning process.

The power required by the tuning circuit should be tapped from the transmitter board. The output from the tuning circuit should be connected to your digital multimeter with alligator clips. Otherwise, you will be too busy holding the meter probes when you tune the coil. To tune the coil, you could start off with the brass or ferrite screws. Slowly insert the screw into the coil and keep an eye on the meter output reading. The reading can decrease or increase depending on which screw you use and how far it is inserted into the coil.

Brass decreases the inductance of the coil but ferrite increases it. Similarly, the inductance of the coil will be increased if it is compressed (small pitch) and decreased if stretched (larger pitch). The whole idea is to insert the screw into the ▶

PARTS LIST — ETI-746

The parts list listed below are only for building up one unit. A complete system consists of two such units, therefore everything listed below needs to be doubled.

Transmitter board

Resistors	(¼W, 1%)
R19	220R
R6	470R
R3, 12	1k
R16	1k8
R9	2k2
R8	4k7
R14	10k
R1, 2	12k
R13	22k
R21	27k
R11, 15	56k
R20	100k
R7	220k
R18, 5	270k
R17	1M2
R10, 4	2M2
RV1	500k multi-turn trim pot
RV2	50k multi-turn trim pot

Capacitors	
C1, 6, 19	2μ2/16V or higher (Tant)
C2, 3, 4, 15, 20	100nF (disc or monolithic ceramic)*
C5	1pF (disc ceramic)
C7, 8, 11	0.47μF/16V or higher (tant)
C9	22nF*
C10	22μF/16V (tant)
C12, 13, 17	150pF*
C14	33μF/25V (Elec.)
C16	22pF (disc ceramic)
C18	47nF (disc ceramic

Semiconductors	
Q1, Q2, Q4	BC549 or BC109 (Bipolar npn)
Q3	BC328 or BC558 (Bipolar pnp)
Q5	BF981 Philips Dual gate MOSFET
D1, 2	IN4148
IC1	CA3130E FET input op-amp
LED1	3mm dia. high efficient LED

Miscellaneous

One 3.5mm mono phono socket (SK1) for the microphone input. A crystal, the one used in the prototype is XT=27.620 MHz (Dick Smith Electronics part number B-9604). Eight 4BA tapped metal spacers with four counter-sink hed 4BA, ½ inch long screws. Half a meter long hook up wires and 6 inches long 22 SWG insulated copper wire for winding up coil L1.

Receiver Board

Resistors	(¼W, 1%)
R27	10R
R35, 36	220R
R25	820R
R34	1k5
R29	4k7
R32	10k
R26	12k
R24	22k
R23	27k
R22	68k
R28, 33	100k
R31	390k
R30	560k
RV3	50k multi-turn trim pot

Capacitors	
C21, 24	150pF*
C22, 26, 27, 30	1nF*
C23	22nF*
C25, 42	10μF/25V (tant) or (Elec.)
C28	0.22μF (tant)
C29, 32, 37, 39, 40	100nF (Monolithic ceramic)
C31	3n3 (disc ceramic)
C33	1pF (disc ceramic)
C34	2μ2/16V or higher (tant)
C35	22μF/16V or higher (tant)
C36	33pF (disc ceramic)
C41	47μF/25V (tant) or (Elec.)

* Philips Subminiature Plate Ceramic's. ref. Philips Data book C15.

Semiconductors	
IC2	Philips TDA1072A AM-receiver
D3, 4, 5	In4148
D6	BF981
Q7	BC549 or BC109
Q8	Philips BSR50 (darlington)

Miscellaneous

Miniature toggle switch (SW1) from Dick Smith Electronics. A 3.5mm phono socket (SK2) for the audio output to the phone. A ceramic filter (CFW455E) from irh components. The RF transformer could be obtained from Dick Smith Electronics again, the catalogue number is L-0260. It is sold in a pack of four, the transformers are distinguishable by their colors. The one you need has a black color slug. One foot long 22 SWG insulated copper wire for winding up L2, 3, L4. Two feet long 28 SWG insulated copper wire for winding the L5 and for connecting the antenna ports from the pc board to antenna socket SK3 on the front panel. Four 4BA counter-sink head ¼ inch long scews for fixing the receiver board onto the spacers.

General Assembly parts

A 9 volt battery clip. A meter of hook up wire. If you are going to incorporate socket SK4 for battery charging or intending to operate the unit from external source, extra socket and a resistor is needed. The socket is 3.5mm phono type with a 330R, ¼ W resistor. The antenna section consits of two one meter long hook up wires and a 2.5mm phono jack. The headset I used in my prototype was from AUDIO TELEX model number 63-500/001 (the 500 series) but other series would also work so long if the mic. and phone impedance matches with the circuit specification. It is understood that the headset and the case (as described ini last issue) may not be supplied in the kit pack.

Parts for the tuning circuit

(Please refer to circuit shown in figure 4)

Resistors	all 0.25W, 1% tolerance
1 X	27k
1 X	10M
1 X	68k
1 X	220R

Capacitors	
1 X	150pF*
1 X	0.1μF (tant) or Monolithic ceramic
1 X	47μF/25V (Elec.)
1 X	1nF (disc ceramic)

Semiconductors	
1 X	BF981 Philips Dual gate N channle MOSFET
1 X	1N4148 small signal diode

Price estimate: $100 approx. per unit (excluding the tuning circuit, the wooden box, battery and the headset)

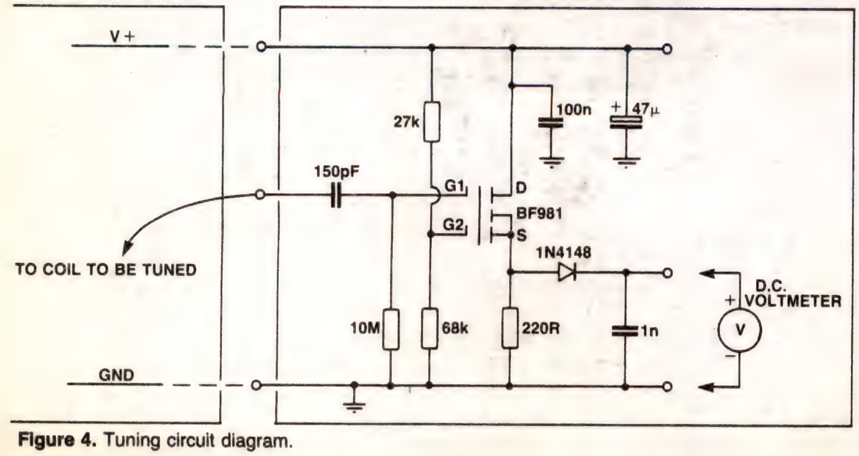
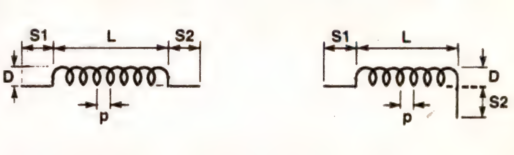
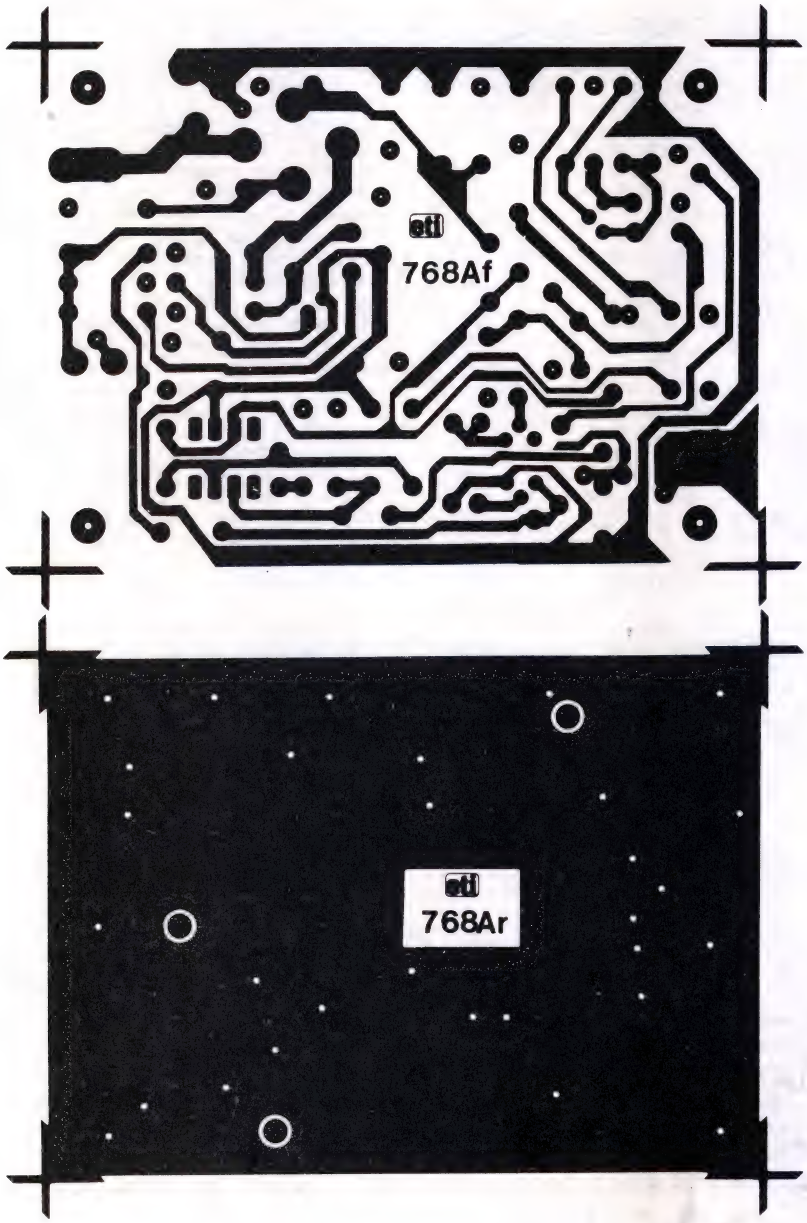


Figure 4. Tuning circuit diagram.



L = LENGTH OF COIL
D = DIAMETER OF COIL
l = LENGTH OF WIRE USED TO MAKE UP THE COIL
d = DIAMETER OF WIRE USED TO MAKE UP THE COIL
p = PITCH OF COIL
S1 = SLEEVE ONE
S2 = SLEEVE TWO
T = NUMBER OF TURNS

Figure 5. The two types of coil shapes.



coil to see whether its inductance is too high or too low for resonance to occur. The reading from the digital meter will increase as you slowly insert the ferrite screw. It generally reaches a maximum point then starts to decrease if the screw is pushed in further. The reading indicates that the inductance on the coil needs to be increased up to the maximum reading. Any further increase of inductance will kill the resonance. So to achieve the climax point, take a note of the maximum on the meter and remove the screw. Now compress the coil slightly, remove your hand from near the coil (as the human body can effect the tuning) and take a look at the reading. If it has already reached the maximum, that's fine, if not, it has either been compressed too far (having too much inductance) or was not compressed far enough. To verify which is the case, you only have to insert the ferrite screw again. If it decreases the reading, you must have compressed the coil too far, in such case, you should stretch the coil.

It is an iterative, tedious process but should not take more than 15 minutes. Please consult table 1 for the tuning readings I obtained.

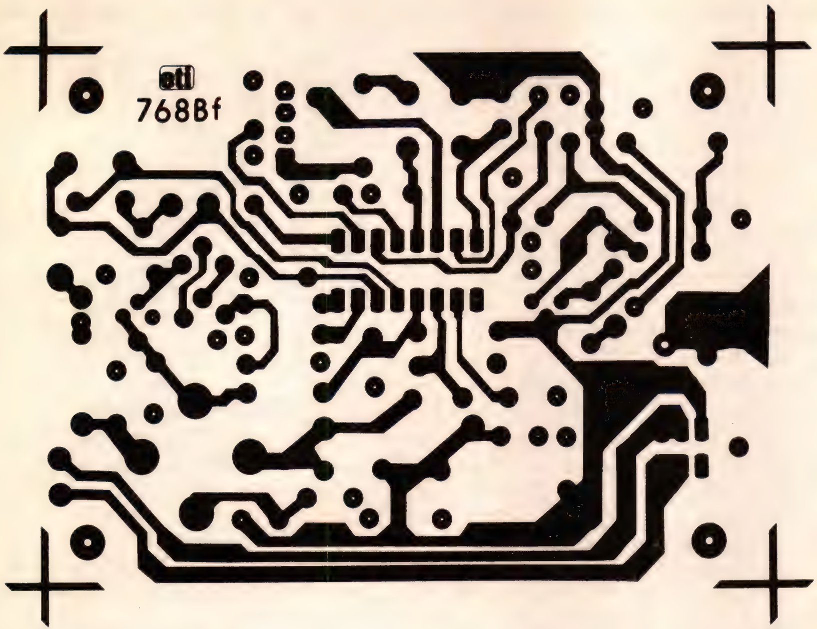
Coil L2, L3 and L4

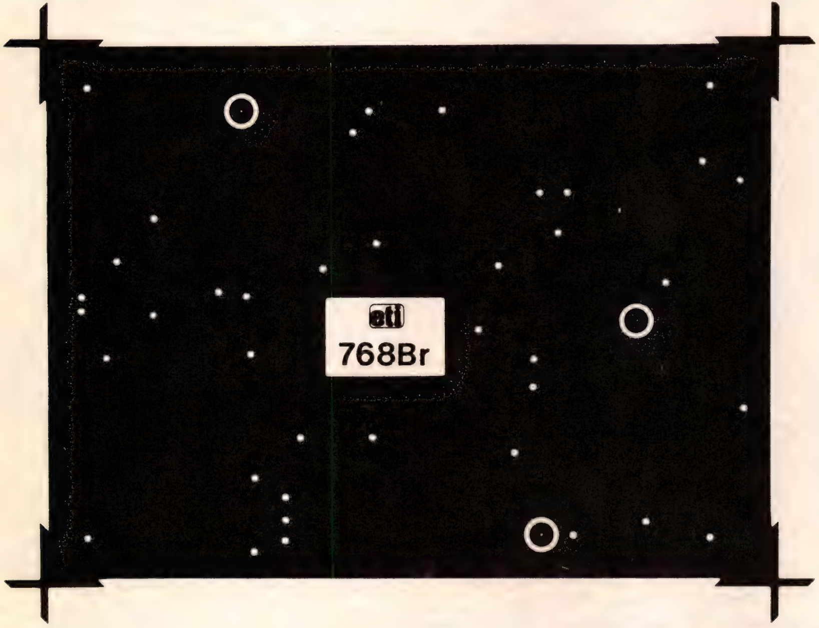
These three coils should be treated together as they are related. To tune them, you must finish tuning L1 in the transmitter. Connect the tip of the transmitter antenna to that on the reciver via a 150 pF ceramic capacitor. The transmitter is now transmitting its carrier to the receiver. This carrier signal is needed in order to tune the coils L2, L3 and L4. Remember that if there is no mic. input signal, the voice operated switch will disable the carrier signal. Since no one has lungs big enough, some means of keeping the carrier going while carrying out the tuning process is required. To do that, please refer to the photograph. There are two tracks very near to each other, located right next to the transmitter crystal. Bridging the two tracks together with solder will bring power supply to the oscillator. A continuous carrier will appear on the transmitter antenna without any mic. signal needed. Don't forget to break the solder link when the tuning is done.

As described above, power to the tuning circuit is either taped from the transmitter or the receiver board. The signal input to the tuning circuit should be taped from the drain of the transistor Q6. When you do your measurement, capacitor C26 should be ac coupling the signal to pin 14 of the IC2. Due to the absence of the impedance existing on pin 14, removing C26 would give you a higher reading on the meter. In fact, the result shown in table 1 was obtained under such a situation (with C26 removed).

Once the tuning circuit is hooked up properly, turn on the power and take a note at the reading on the meter. Slowly insert the brass screw into coil L3 and observe the change in the reading. The fact that coil L2 and L3 are so close together and with their axis parallel make them look like a single coil. The middle gap between the two coils affects the coupling from L2 to L3, but it has nothing to do with the tuning, although the smaller the gap, the better. Therefore, make sure the screw is inserted into the coils from the L3 side, not the L2 side. Again compress or stretch coil L3 as indicated by the screw in order to achieve maximum reading on the meter. You will find L2 does not require much tuning at all as it is merely a high impedance coil to pick up the carrier signal. Inserting a ferrite into L2 (from the L2 side) will deceptively increase the reading, but the increase is not due to the change of inductance, it is in fact, a better coupling between L2 and L3.

The coil which really affects your reading a lot is L4, it is a tuned band pass filter. The amplitude of the received signal, as indirectly indicated in your meter would shoot up to a climax if coil L4 resonates with the C24. In table 1, the maximum voltage obtained from the drain of Q6 is shown when L2, 3 and 4 are properly tuned. Again, don't forget to solder the capacitor C26 back when the tuning is done.





Coil L5

Tuning on this coil is not necessary simply because the turns are closely wound together (pitch is zero). Compressing and stretching it is not possible. So long as the number of turns in the coil is correct, the on chip oscillator should oscillate.

The output of the oscillator can be verified with a CRO on pin 10 of IC2 (the loading resistor R25 must be there to correctly load the oscillator output when being monitored). Alternatively connecting the tuning circuit to pin 10 should give a reading of 0.79 V approx.

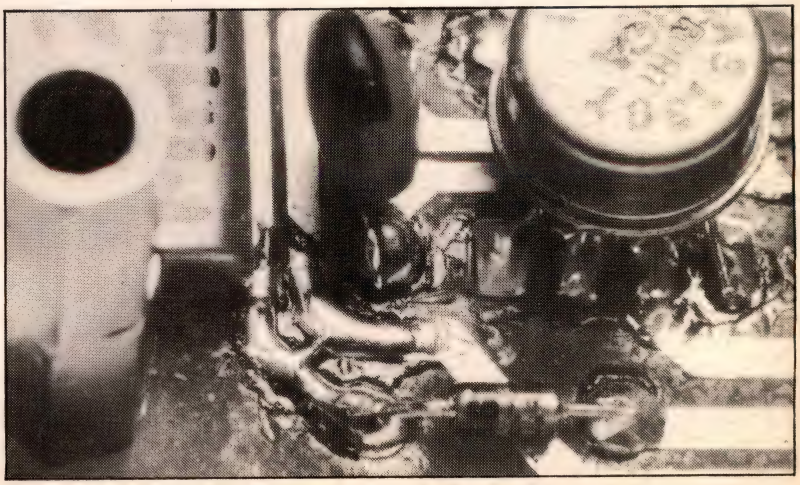
RF Transformer T1

When the coils have been tuned properly, you are ready to receive the best signal by tuning T1. The tuning circuit is not needed here. The set up is similar to the one described above; with the voice operated switch disabled and the transmitter transmitting a non modulated carrier continuously. The 150 pF capacitor joining the tip of the transmitting antenna to the receiving one should be removed to avoid overloading the receiver chip. The carrier signal will be picked up by the receiver antenna off air. Capacitor C26 has been put back into its spot. Use your multimeter to measure the dc voltage output from the internal AGC control on pin 8 while you turn the slug in the transformer. Before you start, unwind the slug on top of the transformer until it can't go any further. Then slowly wind down the slug (clockwise) and keep tracing the reading on the meter. You will experience a slow rise in the reading until it peaks, the down it goes!! The best (sharpest) tuning is the one when the voltage shown on the meter is at its peak. I can't really say what value this peak should be at because it depends on the strength of the carrier signal ▶

Table 1: Various tuning voltages obtained using the tuning circuit as described in text.

Condition: Supply at 12V
One meter long transmitter/receiver antenna fixed in a 'V'-shape for more detailed conditions. see text.

		Unit 1	Unit 2
Transmitter	Voltage at drain of Q5	6.22V	6.34V
	Voltage at drain of Q6	6.15IV	5.6V
Receiver	Voltage at pin 10 of IC2 (TDA1072A)	0.791V	0.790V



Close up of the two tracks which need to be bridged during tuning.

at the time. One caution: you will find your body will affect the reading as well. I suggest you turn to the slug a little, move your body back and read the meter, then repeat until you get the peaking to occur.

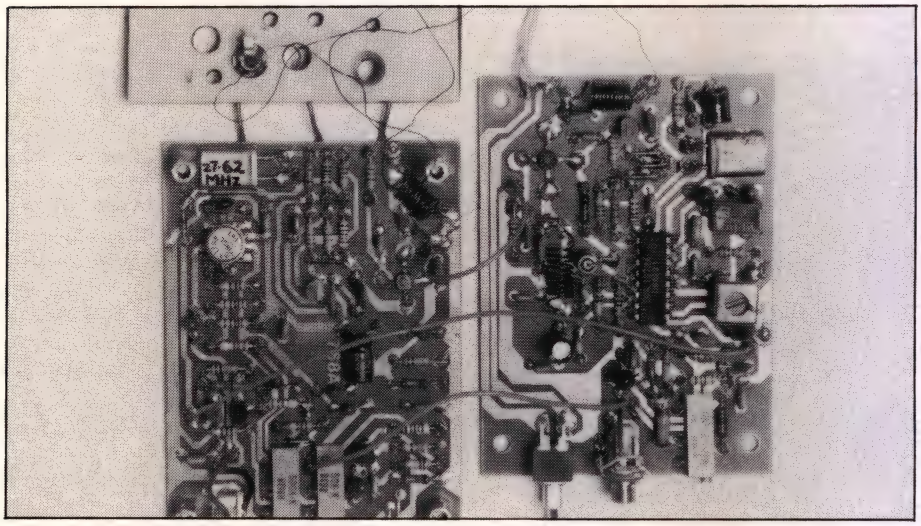
Testing The Unit

Get a friend to help when you try out your first test. Stand 5 metres away from each other, plus your mic. and phone onto the right sockets. Antennas are also plugged into the 2.5mm phono socket ready for action!! Each of you should carry a small, watch screw driver for tuning the trim pots.

Turn on the unit and you will see the LED glow and die away after 2 seconds or so. A lot of hiss should now be heard from the earphone. If the LED glows steadily, you may have your MOD (the trim pot RV1 labelled MOD on the front panel controls the gain of IC1 and hence the depth of modulation) turned up too high. Your breath or the ambient breeze is triggering the voice operated switch continuously. Turn it down by turning the trim pot in anti-clockwise fashion.

SEN stands for sensitivity of the voice operated switch. I personally find that turning the MOD up and SEN down (by turning it clockwise) works quite well. Having the MOD up means you don't need to shout. On the other hand, low SEN means ambient noise won't trigger the unit. Trim pot RV3 controls the volume output on the headphone. Turning it clockwise will reduce the volume output. If everything works fine, just follow the protocol described in the last issue when you communicate.

(Continued page 108)

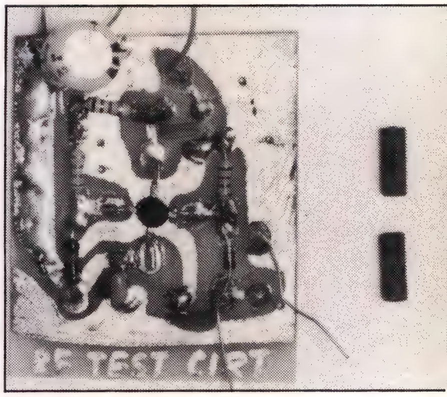


View of both boards and front panel.

Table 2: Information on winding up the coils in the circuit. Please refer the symbols used here to figure 5.

Coil	l	T	d	P	D	S1	S2	L
L1	160	8	0.63 (22 SWG)	1 (approx.)	5.1 (approx.) (13/64 inch)	3	3	9 (approx.)
L2	63	3	0.63 (22 SWG)	0.5 (approx.)	5.1 (approx.) 13/64 inch)	2	4	3 (approx.)
L3	160	8	0.63 (22 SWG)	0.5 to 1 (approx.)	5.1 (approx.) (13/64 inch)	4	4	5.5 (approx.)
L4	190	10	0.63 (22 SWG)	1.5 to 2 (approx.)	5.1 (approx.) (13/64 inch)	3	3	11 (aprox.)
L5	323	19	0.315 (28 SWG)	ZERO PITCH	5.1 (approx.) (13/64 inch)	3	3	6.5 (approx.)

NOTE: The pitch (p) and length of the coil (L) shown in the table is only rough. Their actual length depends on your tuning. All dimensions shown in millimetres (mm) unless otherwise noted.



Brass rod, ferrite slug and tuning circuit.

Coil Construction

To get the idea across efficiently, some jargon will need to be defined (as shown in figure 5).

The physical information for each coil is shown in table 2. Although the data shown in table 2 is quite different for each coil, the way they are made is not all that different. First cut the wire to the exact length as indicated in table 2. Get a sharp blade or scalpel to scratch away the insulating coating on the sleeves for soldering purpose. Wind it up on the specified drill bit for the specified number of turns. It does not matter if you don't have any pitch between turns when you wind it up on the drill. As soon as you release it, it stretches itself anyway. Solder one sleeve onto the pad first, then refer to the picture shown here to get some idea of what the final pitch is like. Pull the other end of the coil with a tweezer to achieve roughly the same pitch and solder it down. This is an important step to ensure you are not too far from the maximum point even the start of the tuning process.

Coil L2 and L3 have one of their ends through the pc board and soldered on the bottom side. They take up a shape as shown in figure 4 (b). As mentioned ini the text, the gap between L2 and L3 should be as small as possible to maximize coupling between them. When it comes to L5, some way of stopping the coil from stretching is necessary as there is no pitch. I achieved that by putting one layer of cellotape onto the winding. Trim the extra bit of tape on the ends of the coil then carefully remove the coil from the drill bit.

Errata

After the basic functions worked, I made several measurements of the transceiver's performance. At first the results were disappointing but these were improved by a few minor changes. Several component values needed to be corrected.

Your circuit will be correctly assembled if you follow the overlay diagram or parts list. The values on the schematic are incorrect. The changed values are IC1, R4, 5,7,9,10,19,32 and C5, 10, 11, 21, 24, 30, 41.

COMING EVENTS

MAY

Photographics '87, an exhibition of equipment and technology of photographics will be held 23 to 26 May at the RAS Showgrounds in Sydney.

Office Technology '87 Show will be held in the Royal Exhibition Building in Melbourne from 31 May-3 June. Contact Ms Mary Young Australian Exhibition Services Ltd, Illoura Plaza, 424 St Kilda Rd., Melbourne 3004.

JUNE

Communications '87, the Australian International Office Technology Exhibition, is on 1 to 4 June at the Royal Exhibition Building, Melbourne. Contact Australian Exhibition Services on (03) 267-4500.

PC87, the Ninth Australian Personal Computer Show is on 1 to 4 June at the Royal Exhibition Building, Melbourne. Contact Australian Exhibition Services on (03) 267-4500.

Office Technology '87 will be held 1 to 4 June in Melbourne. Contact Australian Exhibition Services on (03) 267-4500.

The 1987 Computing Systems Conference will be held 17 to 19 June in Brisbane. Contact the Institute of Engineers, Australia, 11 National Circ, Barton, ACT 2600. (062) 73-3633.

Videotex '87 Exhibition & Conference is on in Melbourne over three days in June. Contact Riddell Exhibitions on (03) 429-6088.

The Australian Hi-fi Show '87 wil be held Sydney 19-21 June at the Airport Hilton; Brisbane 3-5 July at the Gold Coast International hotel; Melbourne 17-19 July at the Dallas Brooks Hall; Adelaide 24-26 July at the Adelaide Hilton.

JULY

Videotex '87 to be held 30 June to 2 July at the Sheraton Hotel, Auckland. Contact the Secretariat on (649) 68-6955.

The Third National Space Engineering Symposium will be held 30 June to 2 July at the Australian Defence Academy in Canberra. Contact The Conference manager on (062) 73-3633.

Automach '87, an exposition on automated manufacturing and sponsored by the SME, is scheduled for 7 to 10 July in Sydney. Contact Adloph Greco on (02) 875-2377.

The 1987 Perth Electronics Show is on again at the Claremont Showgrounds, Perth from 29 July to 2 August. Contact address: 94 Hay St, Subiaco, WA 6008. (09) 382-3122.

AUGUST

A symposium on signal processing and its applications will be held at the University of Qld 24 to 28 August. Those interested in participating contact the Conference Secretariat, ISSPA 87, Uniquest Ltd, University of Qld, St Lucia, Qld (07) 377-2733.

ANZAAS Townsville Conference 24-28 Aug. Examination of Databases, communications and networks, videotext ect. Contact G. Gupta, dept of Computer Science, James Cook University, Townsville, Qld 4811.

Nelcon '87 national electronics conference will be held 24 to 28 August at Auckland University, New Zealand. Contact B. S. Furby on (02) 957-3017, Sydney.

SEPTEMBER

IREECON '87 will feature digital technology when it is held 14 to 18 September. Contact Heather Harriman on (02) 327-4822.

The 4th Australasian Remote Sensing Conference will be held 14-18 September at the Adelaide Convention Centre. Contact John Douglas, South Australian Centre for Remote Sensing on (08) 260-0134.

Communications USA (telecommunications, radio and satellite equipment) in Sydney 21-25 September. Contact Ken Mackenzie on (02) 261-9200.

Labex '87 internationl laboratory equipment and products exhibition is on 21 to 24 September at the Royal exhibition Building, Melbourne. Contact BPI Exhibitions on (02) 266-9799 or (03) 699-9151.

OCTOBER

Computer Indonesia will be held in Jakarta 20-24 October. Contact Australian Exhibition Services on (03) 267-4500.

The 38th International Astronautical Congress will be held in Brighton, England, 10-17 October. The theme 'thirty years of progress in space' will be developed through in series of symposia. Contact the Astronautical Society of WA, COSSA, (09) 397-5642.

NOVEMBER

CommuniTech and Computer '87 is on in Kuala Lumpur 11-14 November. Contact Australian Exhibition Services on (03) 267-4500.

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ADVERTISING INFO No. 16

Inside Your Computer 9

COMPUTER LANGUAGES

In this month's article, we explore the wide variety of languages that will run on a small computer.

Phil Cohen

First of all, what exactly is a computer language? The processor inside a small computer responds to a small set of generally about 200 codes. There's one code (say 34) to get it to copy the value of one location of memory to another location, another code (99, say) to get it to set a particular location to a particular value, and so on. This set of codes is called the 'instruction set' of the processor. A set of such codes in the form of a program is called 'machine code'.

Now, it is possible to write a program in machine code directly — and in fact, that's what people did in the very early days of computing. That was called a 'first-generation' programming language.

Then someone came up with the bright idea of using easy-to-remember 'mnemonics' instead of the codes, and then get the computer to do the translation. So for example instead of remembering to enter a '34' for a copy, they might type in 'CPY' (short for copy), and a '99' might be 'SET'. A program called an 'assembler' did the translation of the mnemonics CPY and SET to the codes 34 and 99.

So far, so good. This was called a 'second generation' language.

Eventually, people started noticing that some things, like printing the value of a decimal number, were used very often. Wouldn't it be nice, they thought, to be able to write a single mnemonic which translated to a whole set of codes which did something that was going to be needed again and again? So 'high-level' languages were born, and the first set of them were called 'third-generation' languages.

One of the first of these 'third-generation' languages was FORTRAN (short for FORmula TRANslator), which allowed people to write things like PRINT A, and have the computer translate (the process was called 'compilation', and the program that did it a 'compiler') PRINT A into a whole sequence of mnemonics, which were then further translated into codes for the processor to follow.

Then the same thing happened to third-generation languages — people noticed that there were some very common requirements which could be replaced by even 'higher-level' mnemonics. An example of a common requirement might be the generation of a printed report from a set of numbers stored in the computer, with totals automatically generated at the bottom of each column of the report. In a 'fourth-generation' language, the command to do this might be REPORT A.

The main difference between third and fourth generation languages, though, is that fourth-generation languages are normally built around a 'database' — basically, a way of storing a lot of information in a very structured way, using disk drives.

> **66** ***Almost every language ever developed for a computer (there have been hundreds) is available to run on a small computer.*** **99**

Now, of course, there are also 'fifth-generation' languages for work in artificial intelligence. In a fifth-generation language (often shortened to '5GL'), you don't actually write a program at all. Instead, you put in a series of statements about what you want to do, and the computer figures out how to go about it. For example, you might enter PRINT A first, then A = B + C, then C = 3 and finally B = 2, and the computer will work out what order to do things in to get an answer.

BASIC

By far the best-known language for small computers is BASIC (Beginner's All-purpose Symbolic Instruction Code). BASIC is a usually third-generation language (although there are fourth-generation languages base on it, like PICK BASIC), and is a little different to other third-genration languages in that it is not usually compiled (although there are compiled versions).

Now, if you remember, compilation is when a program called a compiler takes a series of code words like PRINT A, and turns them into the equivalent set of mnemonics (perhaps a sequence of 100 of them) which can then be 'assembled' into machine codes which the processor can run directly.

With BASIC, however, things are a little different. The processor runs a program called an 'interpreter', which takes each of the commands in the BASIC program — PRINT A, for example — and does what they describe. The difference between this and FORTRAN is a subtle one: with FORTRAN the commands are translated into codes that the processor itself can run, while with BASIC they are interpreted by a program, which does what they describe.

The main advantage of compile languages are that they work very quickly. The compilation process is slow, but once the program has been compiled, it runs very fast. The advantage of an interpreted language like BASIC is that there is no slow compilation process to go through — you can change the program and have it running within a second (compilation can take minutes), even though the program runs more slowly when it is finished.

Languages

Almost every language ever developed for a computer (there have been hundreds) is available to run on a small computer. If you have an Apple computer, or an IBM-compatible machine, you will have the widest choice.

The following languages are all available for microcomputers (and there are many many more):

BASIC: 3GL, compiled or interpreted. Developed specially for beginners, and ideal for small programs.

C: 3GL, compiled. Ideal for applications where speed is important. Most spread-

The famous French mathematician Blaise Pascal 1623-1662.

sheets, word processors, etc, are written in C.

dBase: 4GL, interpreted. Most widely-used language for one-off commercial applications on microcomputers.

FORTRAN: 3GL, compiled. Developed for scientific and engineering applications. Rather old, but widely used.

COBOL: 3GL, compiled. Widely used for commercial applications. Also rather old, very widely used.

ALGOL: 3GL, compiled. Very powerful, used mainly for scientific applications.

PASCAL: 3GL, partly-compiled, then interpreted. Slowly replacing BASIC as a beginner's language. Good for large applications, too.

PROLOG: 5GL, compiled. Just starting to break new ground in the artifical intelligence field.

Running Languages

Most of the languages in this list will need hundreds of K or memory to run, with the exception of interpreted BASIC.

If you want to write your own spreadsheet package in C, you will need a computer with 640K of memory and a hard disk. If you want to run PROLOG, you will need 640K and at least floppy disks.

But to run BASIC all you need is a cheap 'toy' computer and a cassette recorder. Almost every small computer has a BASIC interpreter built-in in ROM. If you want to run any other languages you will have to spend several hundred dollars on extra RAM, and then even more on buying the compiler itself.

If you want to learn about programming, BASIC is still by far the best choice of language. There are some excellent books around which will teach you programming using BASIC, and you can pick up a second-hand computer with BASIC for under a hundred dollars.

Glossary

1GL, 2GL, 3GL, 4GL, 5GL: First, second, etc, generation languages.

ALGOL: A compiled 3GL.

Apple: The company that introduced the first mass-market computer.

Artificial intelligence: A way of getting a computer to find a solution to a problem by trial and error.

Assembled: Translated from mnemonics to machine code.

Assembler: A program that translates from mnemonics to machine code.

BASIC: An interpreted 3GL.

C: A compiled 3GL.

COBOL: A compiled 3GL.

Compilation: The process of taking a program written in a 3GL and translating it into mnemonics.

Compiler: A program that does compilation.

dBase: An interpreted 4GL.

Database: A way of holding all of the information for a program in a structured way.

FORTRAN: A compiled 3GL.

Fifth-generation language: A language developed for artificial intelligence.

First-generation language: Machine code.

Fourth-generation language: A language built around a database.

High-level language: A 3GL, 4GL or 5GL.

IBM-compatible: A computer able to run all of the software written for the IBM PC.

Instruction set: The set of all possible codes that a processor can understand.

Interpreter: A program that allows a 3GL program to be run without compilation.

K: 1024 bytes of RAM memory.

Location: One particular small part of a computer's memory.

Machine code: A program made up of codes that the processor can run directly.

Mnemonics: Short easy-to-remember codes.

PASCAL: A compiled 3GL.

PICK BASIC: A compiled 4GL version of BASIC.

PROLOG: A compiled 5GL.

ROM: Read-Only Memory — the memory that retains information even while the computer is turned off, and which contains all of the programs that came with the computer.

Report: A printed statement showing a list of figures.

Second-generation language: Made up from mnemonics, which in turn stand for machine code.

Spreadsheet: A popular type of financial and accounting program.

Third-generation language: A language which is translated into mnemonics. ●

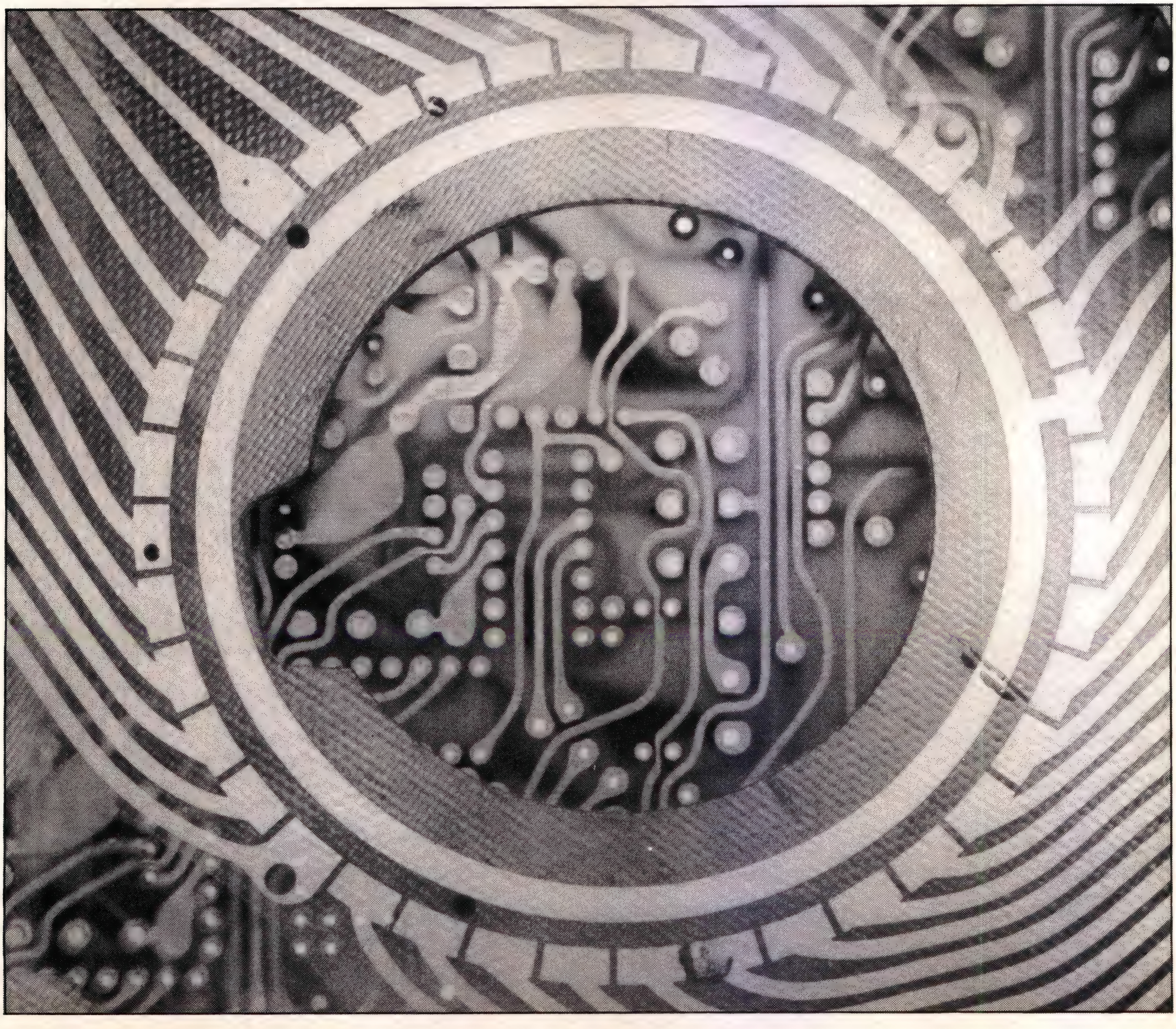
TEACH YOURSELF

CREATING WITH ELECTRONICS 6

RC CIRCUITS DO THE STRANGEST THINGS

Integrating and differentiating are two of the many capabilities of the humble RC circuit. But how? This article explains these functions and more, in preparation for two more useful test instruments to be described in forthcoming issues. As well, the 555 timer is introduced, along with a few points the text books don't tell you!

Peter Phillips



The concepts of differentiation and integration may be unfamiliar to some readers. Mathematically, these processes are somewhat complex, but when related to an electronic application, they become much simpler. Applications of RC circuits are common, usually in conjunction with other devices, as will be found in the next two projects of this series. This article provides background theory for these projects which are an analogue frequency meter and a linear capacitance measuring instrument. These devices offer advantages over their digital counterparts; for example by permitting the easy measurement of low or varying frequencies, and by providing a test for capacitor leakage.

There are three RC applications that comprise the fundamental operation of these two projects; integration, differentiation and timing. Both instruments are based on the 555 timer, and this device is also described. As well, we examine some practical aspects of the 555 that are generally overlooked.

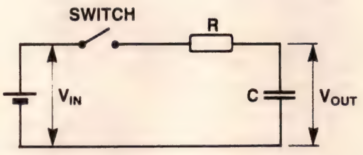


Figure 1: The integrator

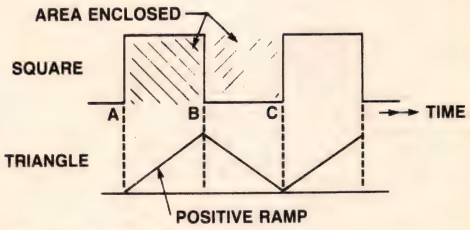


Figure 3: Integrator waveforms

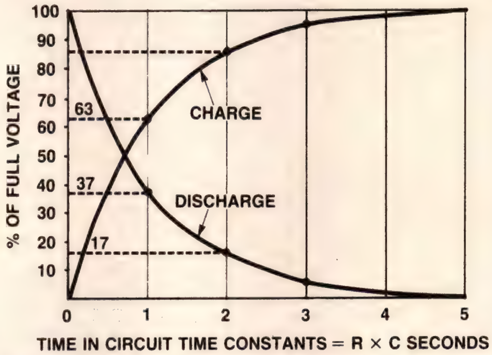


Figure 2: Universal charge-discharge curves

Integration

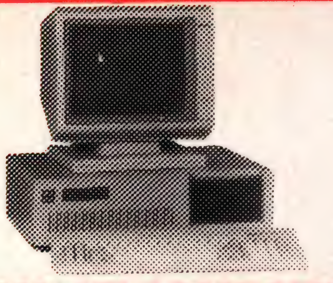
Theoretically, integration is a mathematical process performed on an equation. Eletrically, integration is applied to a waveform, to produce another, different, waveform. To explain, we start with the circuit of figure 1. Depending on its application, this circuit can be an integrator, a low pass filter, a decoupling circuit, or a timing circuit. Any RC combination has a characteristic known as a *time constant*, which is simply the product of the individual R and C values. This time value is used in figure 2, which shows two standard curves that describe how the voltage across a capacitor varies during charge or discharge. When the switch in figure 1 is closed, the voltage across the capacitor will rise towards the battery voltage in the manner shown by the charge curve of figure 2. Replacing the battery with a short circuit will cause the capacitor to discharge as shown by the discharge curve. Because the vertical axis is calibrated in percent of the final value, and the horizontal axis in time constants, the curves of figures 2 are universal, and describe any RC circuit with any applied voltage.

One time constant is, by definition, the time taken for the voltage to change by 63% of its initial value. If R is 1M ohm, C is 1µF, and the input voltage 10 volts, it will take 1 second for the capacitor to reach 6.3 volts. It takes approximately 5 time constants (or 5 seconds for the example) to completely charge or discharge the capacitor. The curves trace an *exponential* shape, and are virtually linear for about the first 20%.

During integration, the output waveform varies proportionally to the area enclosed by the input, meaning the output voltage depends on the input signal's enclosed area as it varies with time. Figure 3 shows how integration of a square wave produces a triangular wave. If elapsed time commences at point A and proceeds towards point B, the area enclosed beneath the square wave will increase linearly. When graphed, the ramp waveform shown beneath these two points results. Continuing towards point C now causes the ramp to fall, because the area, although increasing as point C is approached, is now of the opposite polarity, subtracting from the previous positive value. An integrating circuit of whatever form will produce, therefore, a triangular wave output for a square wave input.

for an RC circuit to behave in this way, the values of the components and the input frequency must be related in a particular way, implying that the RC circuit of figure 1 behaves differently at other frequencies. As an integrator, if the positive half cycle of a square wave at the input causes the capacitor to charge to around 20% of the maximum value, then only the linear part of the charge curve is used. Also, if the discharge time is the same as the charge time, the capacitor voltage will appear to be changing linealy, producing a triangular waveform. Because it takes 0.2 times the circuit time constant (TC) for 20% full charge to be reached, and a further 0.2 TC for discharge, the period of the input signal must be equal to or less than 0.4 RC if integration of the input is to occur. For example, a circuit with a 10k resistor and a 0.01µF capacitor will have a time constant (R x C) of 100µS, giving a frequency (reciprocal of the period) of around 25kHz. The output amplitude will be approximately 20% of the input, but amplification can be then applied if necessary.

Waveform generation for sound synthesis is a common use for the integrator, as is bass boosting in a sound system. Digital voltmeters also use an integrator as part of the process of converting the analogue input to a digital value for processing by the digital circuitry. The forthcoming projects use an integrator to produce a control voltage when the high time of the input square wave exceeds the low time. In this application, the integrating capacitor will charge more than it discharges, and the overall charge will increase in a positive direction, producing a voltage that can be used to operate protection circuitry. ▶



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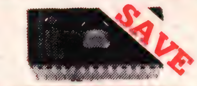

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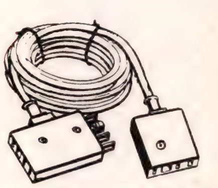

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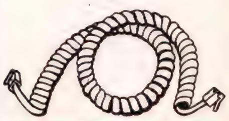

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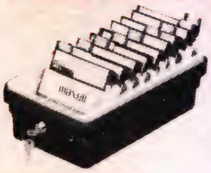

JUMBO 5¼" DISK STORAGE

If you've got lots disks, you'll appreciate the extra capacity of this disk storage unit when it comes to locating "that" disk!

Features...

- 100 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- 9 Dividers/spacers

C16020 .... **only $24.95**
C16027 (Hinged Lid) **$26.95**

5¼" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost!

Features...

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- Lockable (2 keys supplied)
- Dividers/spacers

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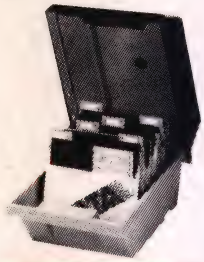

5¼" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost!

Features...

- 50 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- Dividers/spacers

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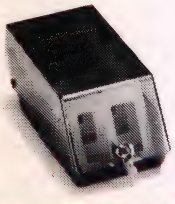

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- Holds up to 40 x 3½" diskettes.
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- High impact plastic lid and base
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Cat. C16035 .... **only $19.95**

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- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through

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Cat. X15651 **Male to Female**
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RS232C NULL MODEM ADAPTOR

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- Pins 2 and 3 reversed
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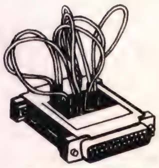

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- 25 leads with tinned end supplied
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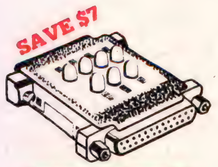

RS232 MINI TESTER

- Male to female connections
- All pin wired straight through
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T.D. Transmit Data
D.S.R. Data Set Ready
R.D. Receive Data
C.D. Carrier Detect
R.T.S. Request to Send
D.T.R. Data Terminal Ready
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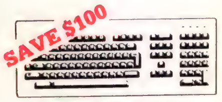

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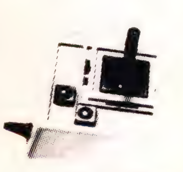

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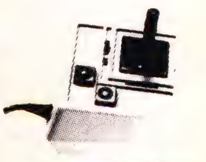

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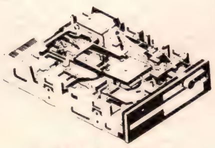

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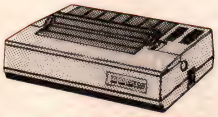

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- Near Letter Quality Mode
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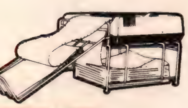

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R.T.S. Request To Send
C.T.S. Slear To Send
D.S.R. Data Set Ready
D.T.R. Data Terminal Ready

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Cat.X19110 .... R.R.P. $169
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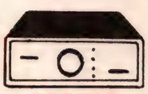

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If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around.

- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector

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4 WAY Cat.X19125 ~~$145~~ $135

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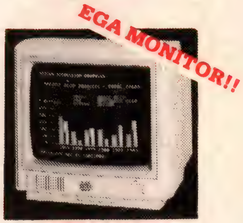
Save time and hassles of constantly changing cables and leads around with these inexpensive data transfer switches. These data switches support the 36 pin centronic interface used by Centronics, Printronics, Data Products, Epson, Micronics, Star, and many other printer manufacturers.

- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector
- Bale locks are standard

2 WAY Cat.X19130 ~~$125~~ $95
4 WAY Cat.X19135 ~~$145~~ $135



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Compatible with IBM* and compatibles, and EGA Cards.
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Dot pitch: .31mm
Display Format: 80 x 25 characters
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CRT: 13", 90° deflection colour
Input Signal:
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Video: Positive
Sync.: Positive
Input Level: TTL Level
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Horizontal: 15.7KHz
Vertical: 60Hz
Display Size: 245(H) x 182(V)mm
Resolution:
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Vertical: 200 lines
Cat. X14530 .... $695

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Active Display Area: 216(H) x 160(V)mm
Display Characters: 2,000 (80 characters x 25 lines)

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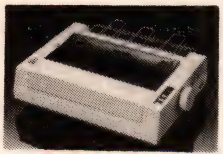

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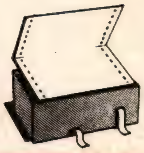

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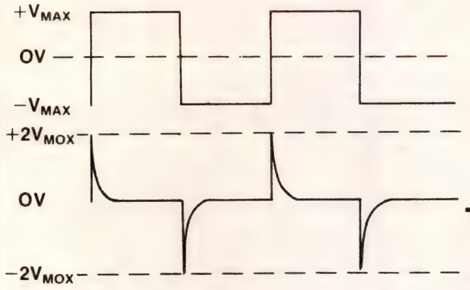

Figure 4: Differentiator waveforms

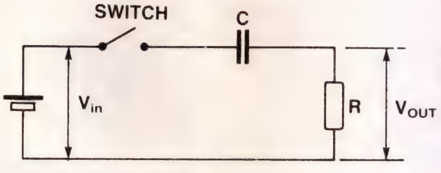

Figure 5: The differentiator

Differentiation

Differentiation is the opposite to integration. When used as an integrator, the voltage developed across the capacitor of an RC circuit is used to produce the integral. If the voltage developed by the current flowing in the resistor is used, a different waveform is produced, and if conditions are correct, this voltage can be used as the output of a differentiator circuit. To differentiate a waveform means to produce an output voltage that is proportional to the *rate of change* of the input. For a square wave, the only time any change is occurring is during the positive and negative transitions of the wave, producing, after differentiation, a series of spikes that occur during the transitions of the input. Figure 4 shows the output of a differentiator, demonstrating that no output occurs when the input waveform is steady between each transition.

Figure 5 shows an RC circiut connected as a differentiator, which is simply a juxtaposed integrator circuit. Again this circuit has other functions, such as a high pass filter, or a coupling circuit in an amplifier. The universal charge/discharge curves of Figure 2 are again used to show the circit's operation. When the switch is closed, the current flowing in the circuit rises from zero to a maximum determined by Ohm's Law, where I_{max} equals the applied voltage divided by the resistance of the circuit. The voltage across the resistor equals the applied voltage at this time. As the capacitor charges, the current, and the voltage across the resistor, finally fall to zero (after 5 x RC seconds). If a short circuit is now applied across the input, the charged capacitor will discharge, the current now flowing in the opposite direction, producing the same waveshape as before, but of the opposite polarity. Figure 4 shows the waveforms that results when the component values and the frequency have the correct relationship. Notice how the output has twice the amplitude of the input.

Using the same component values as before, where R is 10k, C is $0.01\mu F$, and the input voltage $10V_{p\text{-}p}$, the time constant of the circuit will be, as before, $100\mu s$, or 0.1 m S. For differentiation to occur, the capacitor must be able to charge and discharge fully, implying that the circuit's time constant must be short compared to the period of the input. If the input square wave is high for 10 times the TC of the circit, and low for the same period, reasonable differentiation can occur. Thus, the circuit behaves as a differentiator for waveforms that have a period exceeding 20 times the time constant of the circuit. For the example, this gives a period of 2mS, or a frequency of 500Hz. Even lower frequencies will produce waveforms more closely approaching the ideal shown in figure 4.

Differentiators sharpens waveforms, while integrators smooth them. Differentiating a triangular wave will produce a square wave, the opposite to the integrator. A sinewave after differentiation retains its shape, as for the integrator, but with a leading phase difference of 90° to the input rather than lagging. Applications for differentiators include treble boosting in a sound system, enhancing a video signal, and producing trigger pulses for 555 timers.

555 Timer: The theory

The 555 uses an RC network to provide the delays required. It comprises a series resistor/capacitor combination in conjunction with additional circuitry to sense when the capacitor voltage has reached a certain value. Numerous applications are possible using RC timing, and the 555 timer is one. Any timing device requires an input *trigger* to initiate the timing cycle, after which the circuit will revert to its pre-triggered state. Such a circuit is referred to as a monostable multivibrator, meaning the circuit has one stable state. A multivibrator is a generic term, and is a circuit that has two possible states, usually referred to as on or off, and that operates in one of three possible modes, including that of the monostable. The other two modes are the bistable, which has two stable states (also called a flip-flop) and the astable. An astable multivibrator has no stable states, and spends its life oscillating between its two possible states, and is often used as a square wave oscillator operating at a frequency determined by external RC networks.

Figure 6 shows the simplified internal circuit of the 555 timer. There are 5 separate blocks within the circuit, comprising 2 comparators, a flip-flop, a transistor and an output stage. Three internally connected, equal value resistors are used to establish voltages at one input of each comparator. The top comparator will have ⅔ the supply voltage (V_{CC}) at its internally connected input, and the lower comparator ⅓ V_{CC}. A comparator is a device that compares the voltage on its inputs. It will switch high if the positive input is greater than the negative, and switch low when

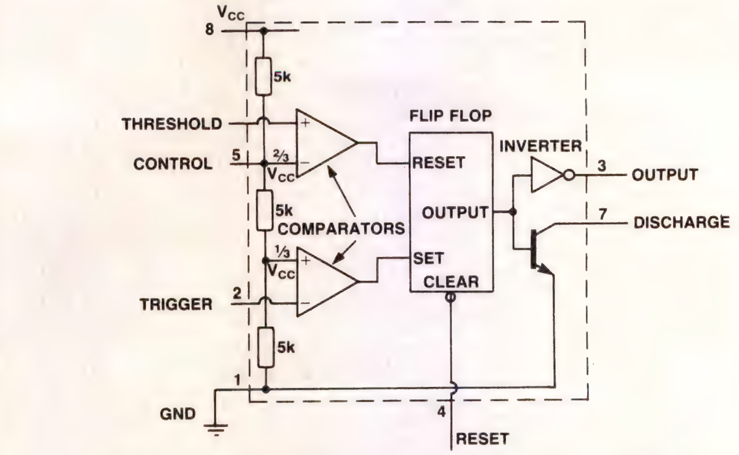

Figure 6: Block diagram of a 555 in an 8 pin DIL package

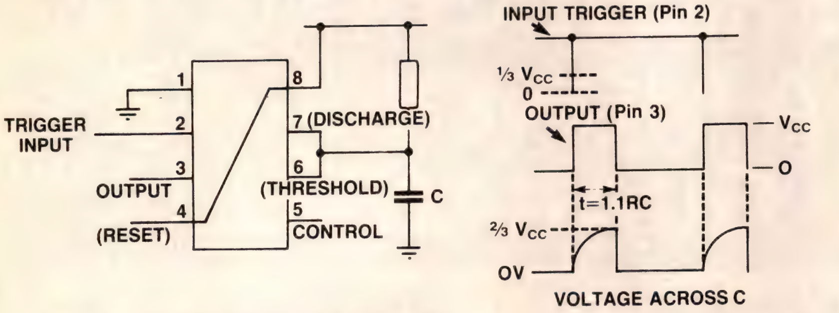

Figure 7: The 555 connected as a monostable

they are the other way around.

The comparator outputs are connected to the flip-flop, the output of which connects to the base of the transistor and to the inverting output stage. The state of the flip-flop will depend on the outputs of the comparators.

Figure 7 shows the circuit of a mono. with the external series RC timing network connected between V_{CC} and ground, and their junction connected to the pins labelled 'threshold' and 'discharge'. While the 'trigger' input is held above ⅓ V_{CC}, the output will be low and the discharge transistor on, placing a short circuit across the capacitor. If the trigger input voltage falls below ⅓ V_{CC}, caused by a short duration, negative going trigger pulse, the trigger comparator will change state, forcing the flip-flop to 'flip' the other way.

Under this condition, the output of the 555 will equal V_{CC}, and the discharge transistor will be off. The capacitor will now commence charging towards V_{CC}, through the resistor. When the capacitor voltage just exceeds ⅔ V_{CC}, the threshold' comparator wiall change state. This then 'flops' the flip-flop back to its original state, restoring the conditions prior to the trigger pulse. How long the timer sends the output high is a function of the RC values, and is calculated using equation 1.

$T_{high} = 1.1RC$ .... (1)

Examination of the universal curves of figure 2 will show that it takes slightly longer than 1 time constant (R x C) to reach the required 67% of the applied voltage, explaining why 1.1 time constants are required.

Practical aspects of the 555

Manufacturers generally quote a minimum value for R of 1k, to prevent excessive discharge transistor current flowing from the supply. The maximum value of R is often specified at 20M ohms, but has a practical limit determined by the leakage characteristics of the timing capacitor. Values higher than 3.3M ohms are generally avoided. The minimum C value is given as 500pF by most manufacturers, but the capacitance meter circuitry breaks this rule, using 100pF. The reset pin, when earthed, is used to interrupt the timing cycle, and should normally be connected to V_{CC} if not being used. The 'control' pin has specialised uses, and is usually connected to ground with a 0.01µF capacitor. Applying a voltage to this pin will vary the time delay by altering the threshold voltage required to end the timing cycle. Use is made of this feature in the capacitance meter.

To derive the trigger pulse, a differentiator circuit is normally used. Figure 8 shows a suitable circuit, which includes a potential divider that should hold the trigger pin at greater than ½V_{CC} in the absence of a pulse. The values of the resistors and the capacitor are determined by the frequency of the trigger input frequency, as previously described. Typically, the differentiator time constant, which must now include both resistors as a parallel combination, should be less than 1/20th the period of the input frequency of the square wave being differentiated. The object is to provide a trigger pulse far shorter than the monostable's on time, to prevent it extending the timing period.

An obscure problem is the propagation delay of the triggering comparator. In some versions of the 555, sending the trigger voltage to, or below zero, causes this comparator to become saturated, delaying its return to the pre-triggered state by up to 10µS. If the output pulse width is in the order of micro seconds, this delay adds to the output, and creates timing errors.

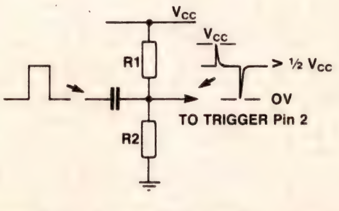

Figure 8: 555 trigger input circuit

Such a problem arose in the projects, apparent only when various brands of 555s were tried during tests to verify repeatability in construction of each circuit. In fixed frequency applications, the triggering circuit can be customised by appropriate component selection. However, when the input trigger rate varies, such as in the project, components that give a short duration, low energy pulse at low frequencies produce a much longer, higher energy pulse at higher frequencies. Establishing correct values for one frequency will cause problems at the other if the range of frequencies is sufficiently broad.

Several options to overcome this difficulty are available, the most obvious one being to switch in different component values to the triggering circuit when range selection is made. Another possibility, chosen for the projects, is to include circuitry that absorbs the extra energy contained within the trigger pulses resulting from the higher repetition rates. Two methods have been employed in the projects, one using a Zener diode connected between the trigger input terminal and the supply. In this arrangement, the Zener will conduct when the trigger pulse pulls the trigger terminal voltage sufficiently low, preventing it exceeding the required value. The second method uses a forward biased diode that conducts at a preset voltage, again limiting the trigger voltage excursion in the negative direction.

Normally, the potential divider connected to the trigger input should provide a quiescent de voltage between half to ⅔ the supply voltage. As already explained, triggering occurs when this voltage falls below ⅓ the supply. For a 12V rail, as used in the projects, a quiescent voltage of approximately 8 volts is provided by the potential divider and triggering occurs when this voltage falls to 4 volts. In theory, any voltage excursion below 4 volts is wasted, and can be clipped off to prevent the saturation problems.

The issue is even more complex however, as theoretically correct circuit values only work form some 555s. It was found necessary to customise the values, depending on the brand of the IC. Two Zener voltages were finally established, 10 volts for the less critical types, and 8.2 volts for the very fussy varieties. No Zener was required for the remainder. Similarly, the amount of forward bias for the diode arrangement vaired from one 555 to another, and as described in the project articles, needs to be established by experiment. The author has previously encountered other differences between 555s, including variations in the output circuit characteristics. A great device, but not as simple as the text books make out . . . ●

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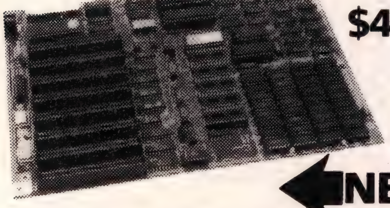

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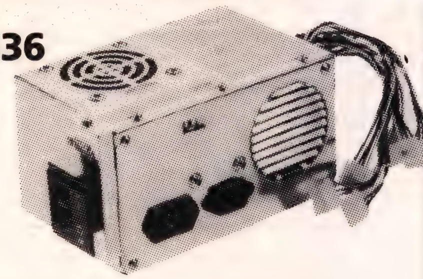

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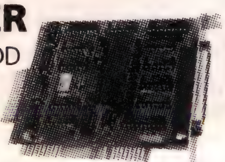

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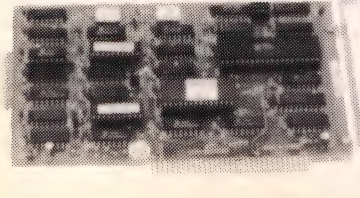

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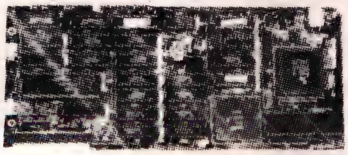

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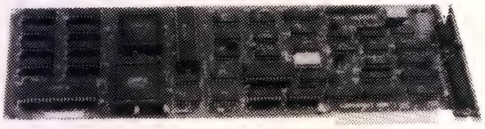

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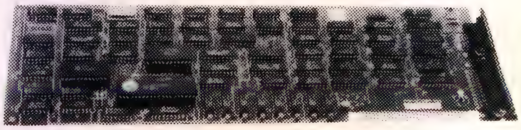

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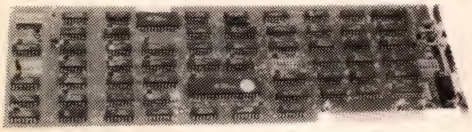

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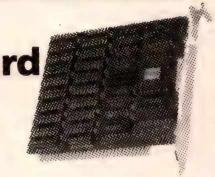

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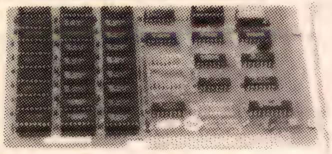

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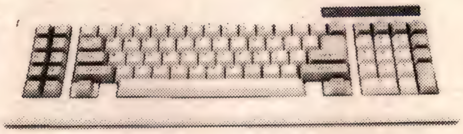

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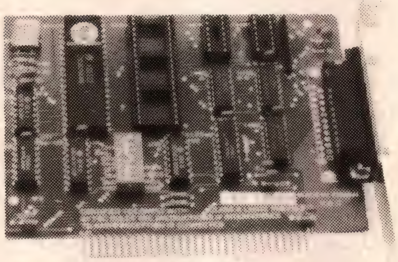

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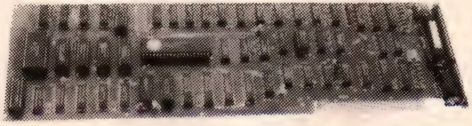

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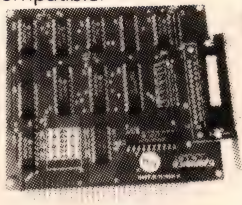

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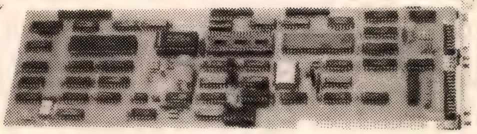

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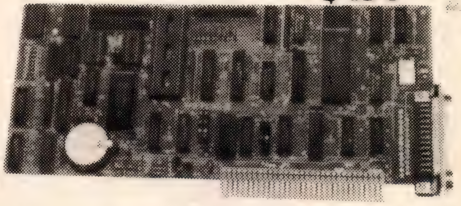

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ELECTRONIC SOLUTIONS

New Eleco wireless microphone system

Audio Telex has announced its third generation Eleco Wireless Microphone System claiming even lower background noise levels than for the highly successful second generation product.

The Eleco Wireless Microphone Systems are already widely used in churches, schools, council chambers, supermarkets and professional sound entertainment systems, radio and TV stations, where quality sound and interference free performances are essential.

The systems operate on 200 MHz which is less cluttered than lower frequencies in the 36 MHz range. The receiver features a dual diversity system, with twin aerials to avoid fade-out.

Priced to suit even the most stringent budgets, Eleco Wireless Microphone Systems are available in hand-held (no antenna lead) or belt pack with clip on lapel microphone. The receiver is table standing or rack mounting.

For further information contact **Audio Telex Communications on (02) 633-4344; (03) 277-5311; (07) 852-1312.**

New 7 segment display

Rod Irving Electronics has released a ½", high intensity seven-segment display. It is available in either common cathode or common anode with overall dimensions of 12.7 mm (w) × 19 mm (h). Display dimensions are 12.7 mm (h) × 7.3 mm (w), each segment being 1.2 mm wide.

Electrical specifications are 3400 wcd brightness; 1.9 V forward voltage; 10 mA continuous forward current; 100 μA reverse current; 5 V reverse voltage/segment; and 120 mW power dissipation.

This red LED high intensity display, excellent for use in kit building, may be used as pin-for-pin replacements for FND500/FN560 and HP5303 displays. The display retails for $1.95 each (up to 10, then $1.75).

For more information contact **Rod Irving Electronics, 56 Renver Rd, Clayton, Vic 3168.**

Optical specs

Alcatel Thomson Gigadisc Corporation of France, OSI, a division of Laser Magnetic Storage International of USA, Philips and DuPont Optical Company of the Netherlands and Sony Corporation of Japan have joined in an agreement on the basic specifications for a family of 130 mm optical disc drives and media, in order to promote the interchangeability of their products.

This agreement is based on American, European and Japanese standardization discussions on cartridges for 130 mm optical discs. The hope is that the agreement will be a basis for further development of a full data interchange capability between 130 mm optical products. The companies are looking for wide acceptance for the specifications and are committed to support such an effort in the interest of developing the industry.

The data format is based on a so-called sampled servo format. This servo format guarantees compatibility with a broad range of optical media based on different technologies, including read only, write once, and erasable media.

The modulation code and the error correction system are designed to match the properties of the optical recording media and the sampled format. A 4/15 modulation code, based on differential detection, and a Reed-Solomon product code for the error correction system have been adopted.

This format allows for a minimum of 300 Mbyte user data on each side of the cartridge.

For further information contact **George Sprague** at **Philips** on **(02)925-3333.**

Protected power source

A 200 W dual-input converter (DIC 200) to meet the need for an effective original equipment manufacturer's power source where protection is required against immediate shutdown in the event of complete or partial ac mains failure has been developed in Britain.

It takes the form of a three-output switched-mode power-supply unit which can accept input drive from either the ac mains or a 48 V dc source. It is normally operated from the mains with the standby battery connected, and a built-in trickle charger ensures that the battery is maintained fully charged. When mains interruption occurs, the unit automatically transfers to the battery and power-supply output is maintained for up to 12 minutes under full-load conditions. Longer hold-up time is possible for a higher battery capacity.

Under partial failure, where input voltage drops below the line regulation limit, the required input is automatically shared between mains and battery to provide the voltage-regulated supply to the host equipment. Immediately mains powers is restored the battery trickle charger resumes.

The converter has three fully floating voltage-regulated outputs: output 1 is set to deliver 5 V with load current from 4 to 25 A; outputs 2 and 3 are identical, each delivering 12 V with load current up to 4 A. Load regulation ensures less than ±2% voltage change on any output, with load variation from 50 to 100%. Line regulation is also better than 2% for approximately 20% change in output voltage. Remote sensing is provided on output 1.

Constant current limiting on all outputs prevents damage from gross overload. Overvoltage protection is provided on output 1.

Failure in computer systems employing data-protection routines prompts signals to indicate reduction of ac or dc input voltage below the lower line regulation limit.

The converter can operate from any standard ac mains supply and meets the safety requirements of most countries.

For more information, long distance contact with **Weir Electronics, Durban Rd, Bognor Regis, England PO22 9RW** is required. Telephone Bognor Regis **744 243 865991**; telex **86543.**

More Tassie software

Tasword PC, a word processor for the PC has been released in Australia.

The Tasword wordprocessors (from Tasman Software) for other computers have been very successful worldwide. In particular sales of Tasword wordprocessors for the Amstrad range of computers have been in the thousands for Australia alone.

According to Tasword, the wordprocessors have been designed for speed, combined with ease of operation and understanding. The features include comprehensive cursor movement control, maximum use of available text memory, on-screen formatting, horizontal scrolling, 'help' pages, delete (character, word, line, paragraph, block), insert (character, line, auto), tab, ruler, search/replace, flex comprehensive and customized print commands, data merge, program customization, tutor program and so on.

At $79.95 retail Tasword PC is on the cheap side of the market. Dolphin Computers, the national distributor, can provide a demonstration disk for only $5 which includes a $2.50 rebate coupon for subsequent mail order purchase of the program.

For more information contact **Arna Gillott** on **(02) 438-4933.**

Dr Bub

Motorola has announced the availability of Dr Bub, an electronic bulletin board dedicated to digital signal processing (DSP). The bulletin board offers the DSP community a wide range of information on Motorola's new line of digital signal processors.

Dr Bub provides the user with documentation on new products and improvements on existing products, application notes, DSP contest information, a confidential mail service, and a question and answer forum. A user can access the bulletin board from anywhere in the world providing they have the following equipment: a 1200-baud modem (Bell 212A or V.22); and a terminal or personal computer.

Motorola to market ear mike

Sydney-based communications company, Heyden-Spike Limited, has signed an agreement with the Motorola Corporation of the USA to market the Australian designed and developed ear-microphone throughout America.

The agreement was reached following a recent visit to Australia by the Product Manager of Motorola, Mr Leonard Bennett.

Motorola will feature the ear-microphone in its America-wide promotional tour which began in February. The six months travelling road-show, with a $1 million promotional budget featuring prominent American actors, is claimed to be the biggest mobile electronics exhibition in America.

The Heyden-Spike Ear-Mike was launched with the assistance of an Australian Government grant and received a gold medal at the Geneva International Exposition of Inventions.

It is both a headphone and microphone, receiving and transmitting voice communications through a hearing-aid type apparatus. The user's speech is picked up from air modulation in the auditory canal and transmitted via the ear piece and 'hands off' equipment carried at the waist.

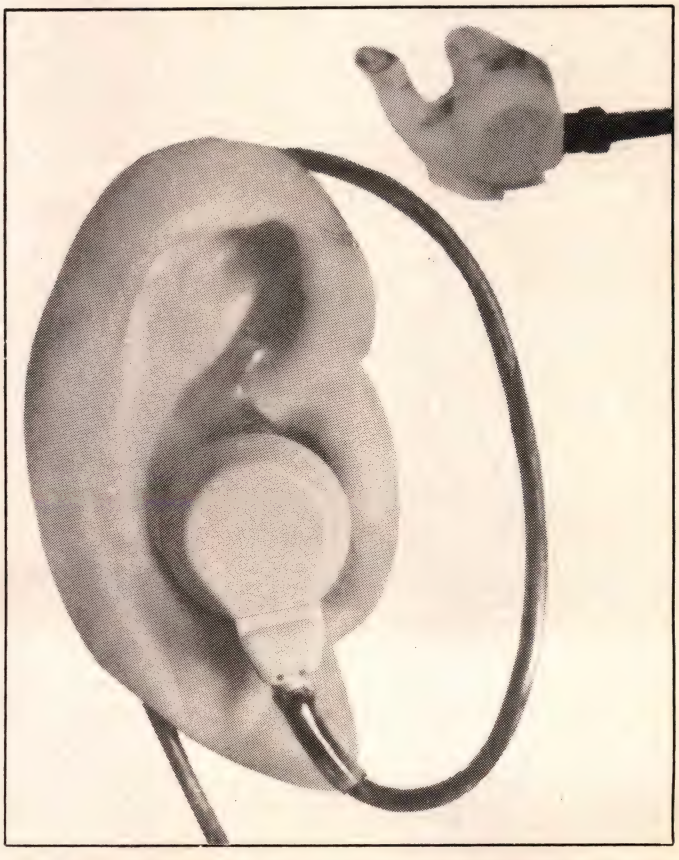
The Ear-Mike can transmit and receive through protective helmets and under high noise conditions, such as at airports and on battlefields, or in covert low-noice surveillance operations.

The US promotion of the Heyden-Spike Ear-Mike will concentrate on public safety applications for police, ambulance and fire brigades, as well as for surveillance work by the American internal revenue service, the military and general industrial applications, particularly in the petrochemical and airline industries.

Sales of the ear-microphone in the US are expected to top 5000 units for the 1987 calendar year with a sales value exceeding $US1.5m.

Strongly directed to export, Heyden-Spike achieved $700,000 in Ear-Mike sales in 1985-86 (12.8 per cent of group sales) and expects this to increase more than fourfold in the next three years.

Back at home, Heyden-Spike has also been awarded a $1.6 million contract from the NSW State Rail Authority for the supply of the latest designed Shinwa portable two-way radio equipment for use by train drivers in the metropolitan network.



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ENGINEERING

TURNING DOWN THE NOISE

Noise is the gremlin of the electronic works; the difference between equations and the real world. A quick round up on where it comes from, what it does, and what you can do about it.

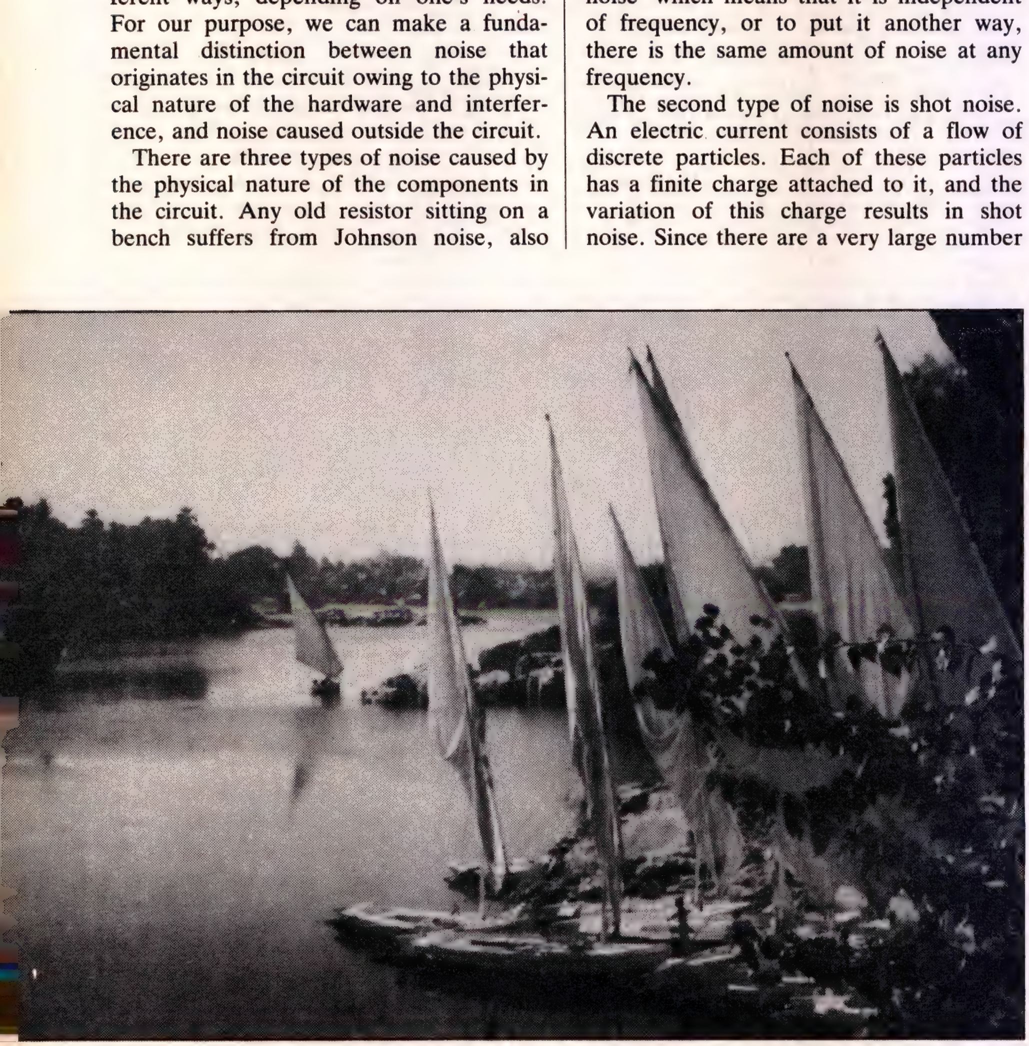
Noise, roughly, is the unwanted part of the output from an electronic circuit. The noise defines the minimum signal strength that is tolerable for the system to work properly. It ultimately sets the minimum discrimination one can make of the signal. Thus noise is the bane of the engineer's life; getting rid of it one of the most important objects in design.

Types

Noise can be classified in a number of different ways, depending on one's needs. For our purpose, we can make a fundamental distinction between noise that originates in the circuit owing to the physical nature of the hardware and interference, and noise caused outside the circuit.

There are three types of noise caused by the physical nature of the components in the circuit. Any old resistor sitting on a bench suffers from Johnson noise, also called thermal noise. It's the result of random movement of atomic particles in the material, and as such, it's an absolutely unavoidable consequence of the physical structure of a conductor. It's dependent on bandwidth and temperature; the more of either the greater the noise. There is only one way to minimize Johnson noise: in applications where noise performance is critical, like satellite communications systems, it is not uncommon to physically cool components. Johnson noise is 'white noise' which means that it is independent of frequency, or to put it another way, there is the same amount of noise at any frequency.

The second type of noise is shot noise. An electric current consists of a flow of discrete particles. Each of these particles has a finite charge attached to it, and the variation of this charge results in shot noise. Since there are a very large number of particles passing at any given moment, it's easy to treat shot noise statistically. It, like Johnson noise, is white.



Both these forms of noise are fundamental to all circuits using physical components. They can't be avoided or altered by buying a different type of resistor, or minimized by clever design. A third type of noise, however, does depend very strongly on the type of material from which the component is made. Real resistances suffer from fluctuations in resistance proportional to the dc current flowing through them. This is called 'flicker noise', or '1/f (one on f) noise'. It can be minimized by good physical design of the component, particularly at the interfaces between differing materials. For instance, in a resistor, the end cap where the resistance material meets the lead is a favourite space for the generation of flicker noise. Redefining its geometry will result in a lowering of this type of noise. Table 1 lists the flicker noise for some typical resistor types.

Flicker noise is called 1/f noise because it is inversely proportional to frequency; as frequency goes up the noise goes down over an equivalent bandwidth. Another way of saying the same thing is that constant noise power can only be achieved by a constant percentage change in bandwidth, so the flicker noise between 1 Hz and 10 Hz is the same as between 100 kHz and 1 MHz. This noise is sometimes called 'pink noise', although 'pink noise' is a term that can be used to cover a multitude of different (non-white) frequency distributions, so perhaps it is as well not to use it.

Curiously enough, flicker noise manifests itself in a number of different and unlikely places. It can be seen in the speed of ocean currents and cars on a freeway, or the flow of sand out of an hourglass and the flow of the Nile over the last 2000 years. No unifying principle has been found for these phenomena.

Measuring

The best and simplest figure for measuring noise is the signal-to-noise ratio. As its name suggests, the SNR is a simple ratio of the strength of the wanted signal to the strength of the unwanted noise, measured at the same centre frequency and over the same bandwidth in root mean squared (rms) volts. This latter point is important, since the absolute value of the noise will increase with the bandwidth, but the signal won't. A practical example of this occurs in FM stereo broadcasting, where it's possible to improve the SNR of a weak signal by switching to mono. The signal strength stays the same, but the mono bandwidth is substantially less than the stereo one.

There are some other values around that also measure noise. One absolute value is the noise power density. This is just the product of the rms noise voltage and the bandwidth it's measured over. For white noise sources this will be a constant of course, but for coloured noise it is necessary to specify the frequency at which the measurement is done, since it will fall off with frequency. Less intuitively convincing, but mathematically more useful, is the square of the noise power density, called the mean square noise density. This is often quoted in data books as Vn^21. The beauty of this unit is that two of them can be added together. Noise power densities can't be added together because they're rms values. (To understand why this is so, you will have to go to any basic electronic maths textbook. If you don't want to do that, you'll have to take my word for it.)

Noise figure is the other popular figure of merit for amplifier noise performance. It is defined as the ratio in dB of the output of the real amplifier to the output of a perfect amplifier of the same gain. In both cases the same input resistor is specified on the input. For a typical amplifier, the noise figure will vary with both source resistance and frequency, which makes it less valuable as a means of comparison between amplifiers. In particular, it's easy to cheat. Manufacturers tend to quote the noise figure at the best possible value of current and voltage, rather than at some standard value.

Semiconductors

Armed with a little knowledge about how noise is measured and manufactured, we can develop a model of how noise is generated in a typical transistor. We start by thinking of a perfect transistor and hanging noise generators around it. There are two, a voltage generator in series with the base, and a current generator in parallel with the base-emitter which creates a noise voltage depending on the input series resistance.

The voltage generator has three components, two white and one coloured. Of the white, one is a Johnson noise component that arises in the base-emitter region. The other a shot noise component caused by collector current creating a voltage across the emitter resistance. The coloured noise is flicker noise derived from the base-emitter current. The result of all this is that voltage noise is constant over a wide range of current and frequency. There will be some wide band noise at sufficiently low collector currents as the emitter resistor goes up, and some low frequency 1/f noise as the base current goes up.

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> ***Curiously enough, flicker noise manifests itself in a number of different and unlikely places. It can be seen in the speed of ocean currents and cars on a freeway, or the flow of sand out of an hourglass and the flow of the Nile over the last 2000 years.***
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> **99**

The current noise behaves quite otherwise. The noise current flowing parallel to the base emitter junction generates a voltage in the source resistance on the base of the transistor. It's main source is taken to be shot noise riding on the steady base current, with some flicker noise thrown in for good measure. The shot noise contribution increases with the root of base current and since it's shot noise, it once again has a white distribution. The flicker noise rises more rapidly in proportion to the collector current. It shows the usual coloured frequency distribution.

Designing for low noise

The situation we have is that noise voltage increases at both high and low levels of collector current, while noise current increases in proportion to collector current. However, the increase in noise current masks the increase in voltage with increasing current. So to all intents and purposes, the art of low noise design becomes one of finding a compromise between noise voltage and noise current. We can minimize noise voltage by increasing collector current, or minimize noise current by reducing collector current. We can't do both at the same time.

In order to determine the contribution of each to the total noise of the system, we must first turn the noise current into a voltage. This is done by impressing it across the source resistance of the device. Effectively then the amplifier noise is being added to the noise riding on the input signal. Since these two are uncorrelated, we may add their rms values, and try to set up things such that the total reduces to a minimum. For any given input resistance and frequency, that's an empirical matter, usually solved by looking at a manufacturer's graph of the noise voltage and current against collector current.

It does lead to some practical suggestions, however. One is that if source resistance is low, the contribution from current noise will be reduced, so the design of the amplifier should emphasize low noise voltage, ie, have high collector current. The converse is also true: a high source impedance will increase noise current, so the designer should concentrate on minimizing it via decreased collector current.

Another suggestion is that if the source impedance is very low, say 50 ohms, the noise voltage will always dominate and the noise performance of the amplifier will be poor. This is why a transformer to raise the effective source impedance is a common feature in such amplifiers.

By the same token, if the input impedance is very high, then the best device for the input is probably a FET. Because of their high input impedance, they present a very small input current, so the contribution of current noise is minimized. In general, a FET will turn in superior performance under these circumstances even though its drain current is probably more noisy than the collector current of an equivalent transistor. ●

Table 1. Typical excess noise for some different resistor types.

Carbon composition	0.1 μV to 3 μV
Carbon film	0.05 μV to 0.3 μV
Metal film	0.02 μV to 0.2 μV
Wire wound	0.01 μV to 0.2 μV

From Horowitz and Hill, *The Art of Electronics*

INSTRUMENT CONTROL

A look at the way modern instruments can be joined together and controlled, especially in automatic test systems.

The scope of automated tests systems has been increasing rapidly in recent years. While specialized instruments are used in certain clearly defined applications, there are many areas where a dedicated system cannot be justified in view of the wide range of measuring problems to be solved.

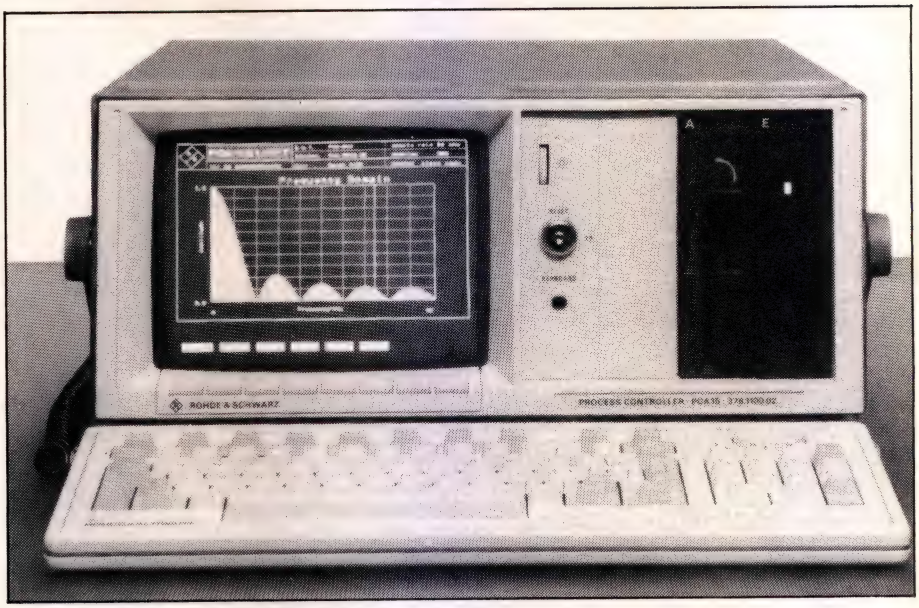
Combining measuring instruments into a system often gives big practical problems as each manufacturer has (or had until recently) his own conventions for remote-control and data signals, his own type of connectors, etc. Even instruments made by the same manufacturer often gave interconnection problems. They were often controlled by parallel wire, separate wire per function types of interface with a wide variety of electrical and code specifications. With this type of system the number of wires vary enormously between instruments, for example a synthesizer may have 80 control wires and 1 output, a digital voltmeter could have 6 control and 30 output wires, and a simple transducer may just require 3 controls. It was the responsibility of the ATE manufacturer to provide the necessary interfacing electronics between such instruments and the controlling source.

The automation of such a system — if possible at all — can present serious interfacing problems, which are time-consuming and costly to solve. These problems, became worse when people started connecting measuring instruments with computers, minicomputers and microprocessors.

The only way out of the above-mentioned difficulties was the introduction of an internationally standardized interface. To make this solution effective, all manufacturers of measuring, control and recording instruments must adapt their instruments to this standard interface.

TABLE 1

IEC 625	International Electrochemical Commission Standard number 625
IEEE 488	Institute of Electrical and Electronic Engineers Standard number 488
HP-IB	Hewlett Packhard Company Interface Bus
GPIB	General Purpose Interface Bus



PCA15 instrument controller from Rhode and Schwarz.

The IEC (International Electrotechnical Commission) therefore decided to take upon itself the task of defining a standard interface for measuring instruments. Of the various proposals which reached it, it took the HP ASCII interface bus as the basis for its standard, elaborating this by adding certain details and increasing the sharpness of definition.

The resulting international agreements are laid down in IEC publication 625-1 "Standard Interface Systems for programmable measuring equipment."

It goes under a number of different names, which are listed in Table 1. All refer to essentially the same thing.

The bus

The bus contains sixteen signal lines which are divided into three groups as shown in Fig. 1. The data bus of eight lines is used for all device dependent messages and a high proportion of interface messages which take the form of a single byte. The true (or logical '1') state of the data lines (and all bus lines) is low voltage, both being approximately TTL standard levels. The transfer of each byte of information over the data bus is controlled by a three-wire handshake process between the source of the byte and all the destination device interface, using the DAV, NRFD, NDAC lines. The handshake cycle guarantees correct information transfer with any combination of device response times. The third group of signals are the interface management lines, the purpose of which is as follows:

IFC	Interface Clear — used by a controller to place the whole of the interface system into a known quiescent state.
ATN	Attention — specifies in general whether the data bus holds interface messages (true) or device dependent messages (false).
SRQ	Service Request — used by a device to request an interruption of the current bus traffic.
REN	Remote Enable — used by a controller to enable and disable device interfaces.
EOI	End or Identify — is a dual purpose line used either to indicate the end of the multibyte message or as a strobe in a parallel poll sequence.

Architecture

Roughly speaking, we can subdivide IEC-bus-compatible instruments into the following classes:

Listener. A listener device can receive data from other instruments. Examples are: printers, display units, programmable power supplies and signal sources.

Talker. A talker device can send data to other intruments. Examples are: Voltmeters and counters with data output facilities, tape readers and data loggers.

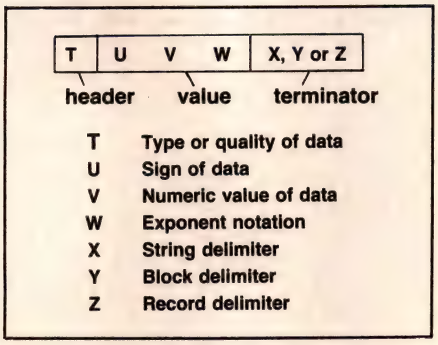
Controller. A controller device can control the information traffic on the bus lines. The controller determines which device has to send data and which are to receive. The controller can also send special commands and control signals.

Each device has its own address. Before data transfer can take place between a given pair of devices, they both have to be addressed by the controller. In general, a controller will be a kind of computer (this term being used here to include minicomputers and microprocessors). However, any device, e.g. a printer, could be given a control function in its IEC interface.

The communication between instruments of an IEC bus system is organized on well defined rules. For example, only one device at a time can "talk" (transmit data over the bus), while several can "listen" (receive messages) simultaneously. The rate at which information is transmitted is automatically adapted to the speed of the instrument which is slowest in processing information.

Since a controller passes information (such as device dependent programming instructions) regularly to the bus, it must have a "talk" function in addition to its "control" function. It will generally also have a "listen" function too, in order to enable it to know that information is passing along the bus (and of course to receive information itself). It is also possible for a given device to act as both a talker and as a listener at the same time.

A further complication is the possibility of sending two special control messages, "interface clear" (IFC) and "remote enable" (REN) to turn a control function into a "system control" function; the device in question is then called a System Controller. IFC and REN are general interface-management messages. The structure of the IEC interface of a device determines whether the instrument can function as a talker, listener or (system) controller. Apart from the above-mentioned interface functions of talk, listen and (system) control, the IEC interface can also contain other functions. The "handshake" functions play an important role in data-byte transfer control. A talker must contain the "source handshake" function in addition to the "talk" function, while all IEC-bus-compatible instruments must have an "acceptor handshake" function.



T	**Type or quality of data**
U	**Sign of data**
V	**Numeric value of data**
W	**Exponent notation**
X	**String delimiter**
Y	**Block delimiter**
Z	**Record delimiter**

Figure 2: The structure of an IEC byte together with the contents of each section.

Formats

The object of this part of the standard is to define a limited family of preferred message codes and formats in a relatively device independent manner so that the highest degree of compatibility can exist between instruments from different manufacturers and between both simple and complex devices. It should be possible to decode messages with a minimum of circuitry and to communicate directly between instruments without the need for translation and re-transmission of messages in alternative formats. The degree of standardisation that is possible in a particular device will, of course, depend to a large extent on the nature of the device and its practical application.

The formats are applicable to three broad types of data. A fourth type, data for display to human operator, by its nature requires a completely free format and would only conform to the terminator conventions. The three types of format are:

(1) Measurement data, i.e. measured results and other data gathered or generated by the instrumentation.

(2) Programmed or Control data, i.e. instrument commands and settings usually generated from the stored test program.

(3) Status data, i.e. the contents of the status byte transmitted during serial poll and giving overall information about the condition of a device.

The form of message used in types 1 and 2 has three main sections: A header containing codes to indicate the type or meaning of the main data part which follows it. The whole message unit is then terminated by special delimiter characters as in Figure 2. Within these sections it is useful to define particular fields not all of which may be present, but which enable consistent decoding of the messages. The table defines the fields and their meaning, contents and preferred character sets.

Instrument readings are sent over the bus via the talker function and may typically go to a recording device as well as the controlling device in the System. The ▶

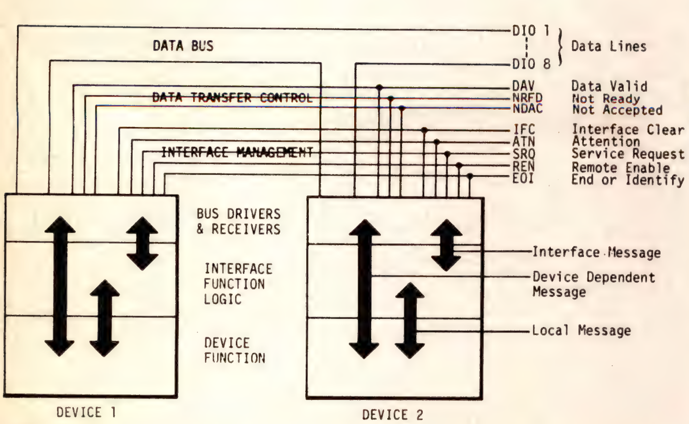
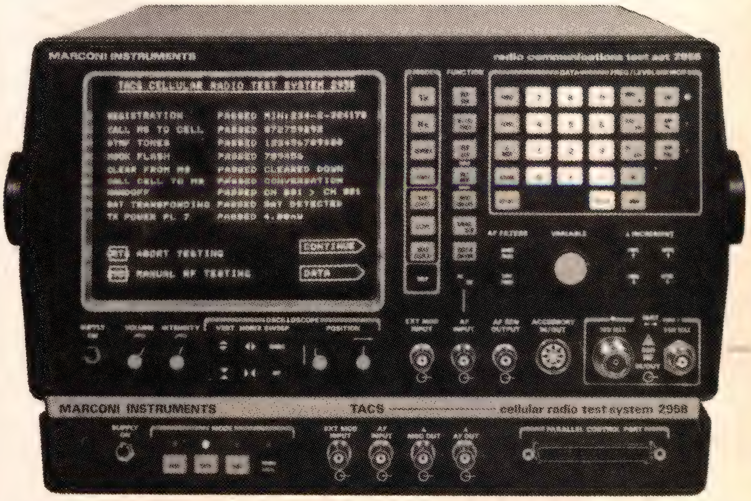


Figure 1: IEC Signal lines and messages.


MARCONI INSTRUMENTS
radio communications test set 2955
TACS CELLULAR RADIO TEST SYSTEM 2958
MARCONI INSTRUMENTS
TACS
cellular radio test system 2958

A cellular radio test set. An adaptor, the Marconi 2958 talks to the Marconi 2955 via GPIB general format of the message is chosen to accommodate a wide range of device requirements while still permitting simple decoding. The message can therefore contain the alpha header, any length of numeric values in one of the above forms, and one of the terminator fields.

In common with all messages the fields are transmitted in order left to right and within a field the most significant character is transmitted first.

Languages

Many companies have developed languages which can be used to control their instruments. For instance Marconi Instruments Autotest Systems have been programmed in test languages such as 'INCITE' and 'MI-BASIC' which have been derived from the simple computational language Dartmouth BASIC. With the new system architecture corresponding changes have been introduced into the software to produce a new version of the test language, known as 'XBASIC'. The earlier languages were produced in interpreter form or compiled form, the former having the advantage of instant high level program and instrument manipulation by the operator, and the latter allowing only fast test program execution. 'XBASIC' is constructed in semi-compiler form which retains most of the benefits of both earlier systems. This is achieved by packing the source program at load time into an intermediate code which is both fast to execute and which retains 1:1 relationship to the source program so that it can be automatically regenerated when required for lising or editing etc.

The software package contains a BASIC language processor to which may be added any number of modules which:

(1) provide additional commands,
(2) drive specific computer peripherals,
(3) handle the GPIB messages to and from specific instruments.

Thus for a particular set of equipment and range of test capabilities a complete software package may easily be assembled allowing high level test programs to be written and executed. For shorter term applications or when some instrument handler modules are not available, the basic language processor is able to control GBIB instruments in a lower level via general purpose bus commands.

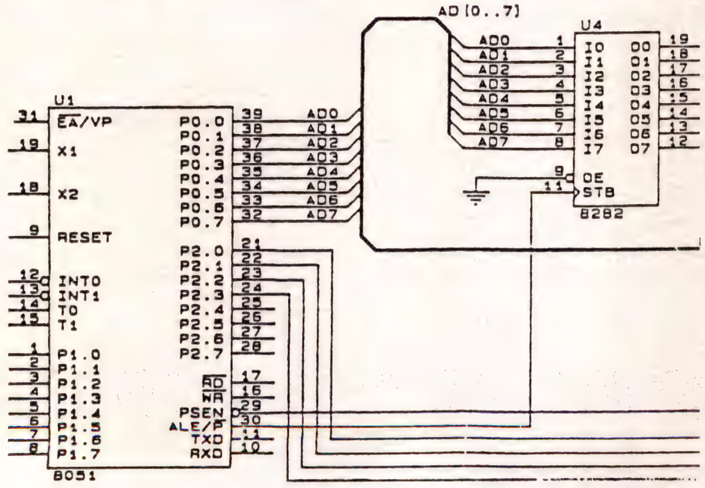
BASIC programs consist of a sequential list of statements which have, in general, four parts

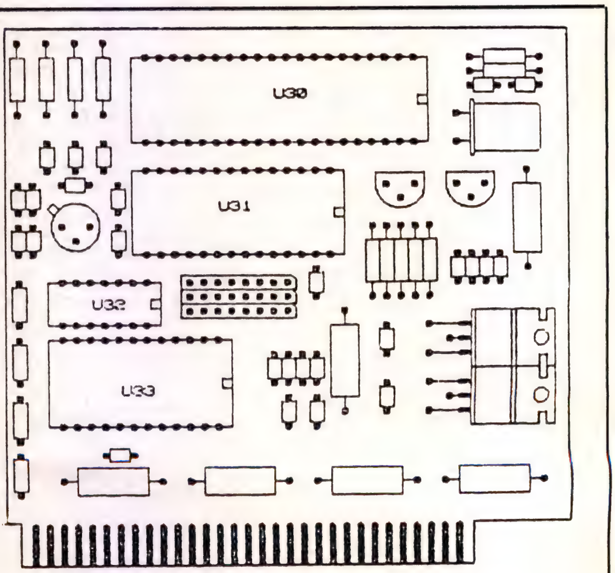
Line number : Command verb :
Qualifying test : Terminator

Line numbers serve as the statement references for both editing and program branching purposes, and when a statement is input without line number it is actioned immedaitely instead of being added to the stored program. Command verbs are provided for a wide range of operations, some of which are only used in immediate mode (i.e. without line number) for program control or editing. Each command verb will have qualifying text, the syntax of which is chosen to suit the nature of the verb. The terminator may be either the carriage return at the end of line or the full colon between statements on a multi-statement line.

The language processor checks the source program syntax at load time and reports any errors. Further error messages can occur while a program is being executed, particularly when fault conditions exist in GPIB instruments or computer peripherals.

IEC 628, in one of its various guises, is now the recognised standard for instrument makers all over the world. Moreover, the manufacturers have elected to support the standard by making their machines truly compatible with it. The result is that instruments can be bought on the shelf and slotted into the most complex of experimental test set ups without undue fuss. This in turn has had an effect on the willingness of engineers to adopt programmed test procedures. ●





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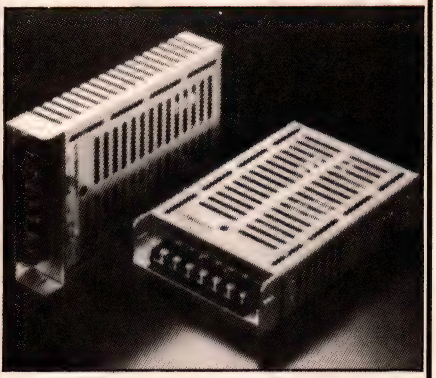

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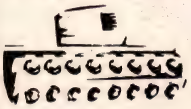

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THE THERMIONIC CATHODE

Although the old-style vacuum tube has all but given way to solid-state devices, there are still many areas where the thermionic valve reigns supreme. This article summarises the steps leading to the development of the modern cathode.

JOHN BELL

Up to, perhaps, twenty-five years ago, a large part of the training of personnel involved in the radio and electronics industries was centred around understanding thermionic valves and their associated circuits. Indeed, for some fifty years, thermionic valves using oxide-coated cathodes were almost exclusively used in the domestic, military and industrial market, until such time as the invention of the junction transistor led to their replacement in most circuit applications.

Because today almost all radio and electronic equipment is constructed using solid-state devices and because the theory and operation of vacuum tube devices has largely disappeared from courses of instruction, it is easy to assume that the thermionic valve is obsolete. This is not so. Certainly, the triodes, tetrodes and pentodes which proliferated in radio and electronic equipment until the 1960s are, with few exceptions, no longer manufactured. Nevertheless, the vacuum tube still survives to meet special applications characterised by cathode ray and television tubes, and microwave generation and amplification. To meet the demands of television, instrumentation, medicine, radar, and satellite communications, some hundreds of millions of vacuum tubes employing thermionic cathodes are still manufactured each year.

Early Days

One of the critical technical challenges faced by the early pioneers of radio, was the unavailability of efficient devices which would enable them to generate specific frequencies, amplify or otherwise process signals. These constraints thwarted their efforts to realise the potential of radio communication, even in simple form. To meet the demands of their new science, they required a range of active devices, which, when connected to external circuits, would allow the generation, amplification, and detection of signals to take place.

The solution to this requirement for active devices was found in the development of the thermionic valve following investigations by Ambrose Fleming, Lee de Forest, and others in the early 1900s. These early valves used a variety of directly heated filaments as cathodes to provide a source of free electrons, the majority of which would be collected at the anode under controlled conditions. Eventually tungsten became established as the filament used in high anode voltage applications, with thoriated tungsten being used for lower voltages: these are known as

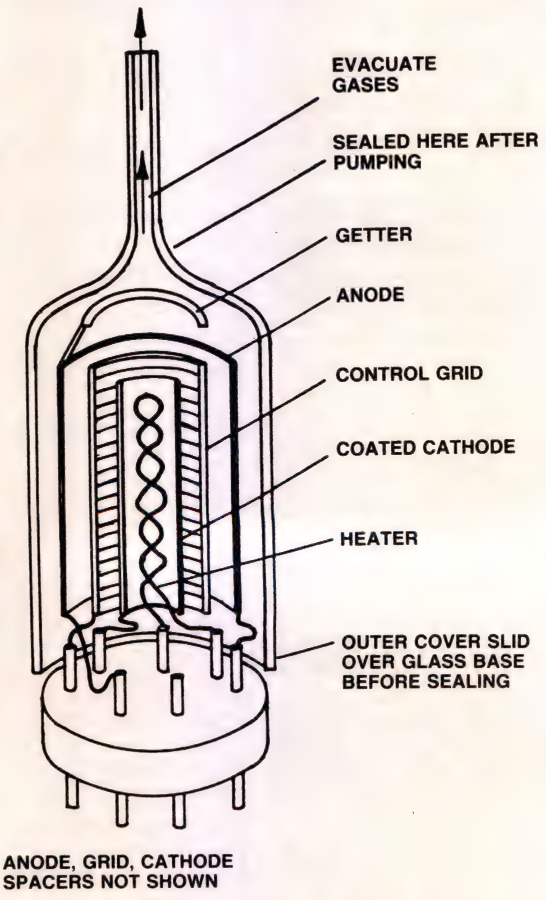
EVACUATE GASES
SEALED HERE AFTER PUMPING
GETTER
ANODE
CONTROL GRID
COATED CATHODE
HEATER
OUTER COVER SLID OVER GLASS BASE BEFORE SEALING
ANODE, GRID, CATHODE SPACERS NOT SHOWN

Figure 1: Cutaway of indirectly heated Triode

bright and dull emitters respectively, having corresponding operating temperatures of about 2100 degrees and 1600 degrees.

Unfortunately, these high operating temperatures pose problems that make them unsuitable for use in simple low voltage circuits. Valves were needed that would provide adequate amplification, long life, and predictable characteristics with minimal heater power. These objectives were finally met with the introduction of the oxide coated cathode.

Initially, valves made with oxide coatings were inferior to those using metal filaments. However, when Wehnelt and Jentzsch discovered the importance of a hard vacuum inside the glass envelope, cathode oxides really took off. As a result, the mass production of thermionic valves using oxide coated cathodes was not possible until the early 1920's, when appropriate manufacturing technologies were available and an elementary understanding of the underlying physics was developed.

Central to this is the idea of thermionic emission. Electrons are emitted when some metals are heated, and, if a strong enough electric field is present, the electrons will flow under the control of the field. In order to increase electron emission significantly, either the cathode temperature must be increased, or the emitter material must be carefully chosen to maximize emission.

Another advance was to indirectly heat the cathode, i.e: to use a separate heater element near the cathode.

The advantages of an indirectly heated cathode are that its emission per unit area is high compared with a directly heated filament, and that its geometry may be more precisely organised with respect to other components and special needs. Possibly, the principal disadvantages are that a separate heater is required which must normally be fed from a separate low voltage ac supply whose alternating magnetic field may introduce "hum". There is also a longer warm-up time before the emitter is able to reach its optimal operating temperature.

Basic assembly

One of the essential steps in manufacturing oxide-coated cathodes, whether directly or indirectly heated, is the preparation of the emitter paste. In preparing the paste, the manufacturer must be scrupulous in using pure materials and clean processes because the presence of even minute portions of foreign material may adversely affect the amount of emission achieved.

To assist in controlling contamination, manufacturers usually make their own carbonate pastes using approximately equal quantities of barium, strontium and sometimes calcium carbonate. The resultant paste is well mixed before other chemicals and solvents are added which will enable the paste to stick to its supporting structure. The layer of carbonates is spread as uniformly as possible over its supporting cathode structure to avoid hot spots or other undesirable effects. The best compromise for many years was the application of paste to a nickel or nickel alloy support.

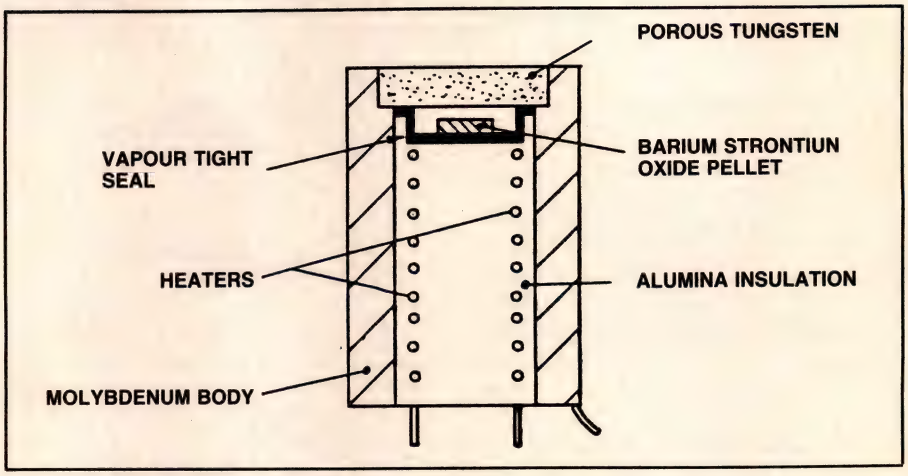

Figure 2: M Type dispencer cathode

Once the structure is assembled, as in Figure 1, the outer envelope is attached, and the outer envelope to glass base sealing process commences. At the same time, additional eddy-current heating is applied to commence the out-gassing of the internal structure; when the outer envelope is attached to the base, the valve is evacuated using diffusion pumping through the top and the heaters energised so that the carbonate paste is reduced to an oxide film. This latter process, which one can actually observe by the colour change, activates the cathode: the valve is then sealed. Finally, the getter is fired (using eddy-current heating) to deposit a thin metallic film on the inside of the glass envelope well away from critical parts: the getter improves the long-term high vacuum characteristics of the valve by allowing residual gases to physically and chemically combine with the layer. Once the vacuum is destroyed the getter is oxidised too: a powdered getter is the sure sign of a dead valve!

The time, under automated conditions, to seal and activate a small tube is a matter of minutes: larger devices, such as a television tube, are baked for about half-an-hour prior to sealing and activation of its cathode(s).

Following this, the valves are frequently burned-in: that is, the filaments are heated at above normal ratings for up to several hours whilst anode current is drawn to improve the emission characteristics.

Emission Life

In general, emission characteristics remain reasonably constant, providing the vacuum is maintained during the early life of the tube. Valves are robust and can often withstand short-term application of an over-voltage to both heaters and anodes without damage to the cathode system (unless the heater filament goes open-circuit). Indeed the application of an over-voltage can help to reactivate an oxide-coated cathode (especially if the getter can be reactivated too) — in fact one trick used to prolong the life of television tubes was to feed the heater through a step-up transformer once the screen brightness had faded. The deterioration of emission is generally associated with the poisoning of the cathode due to several possible causes. There may be leakages through the glass envelope (eg at pin-glass interfaces) and gases will be released from various parts of the assembly through normal operating life, more so under high temperature conditions, with which the getter will be unable to cope. The barium in the emitting surface tends to vaporise with time and finally positive ionic bombardment of the cathode may occur.

The oxide-coated cathode may be damaged in practice by the excessive application of electric fields. Electrons may be dragged from any emitter by the application of a high voltage to an adjoining electrode. This is called field emission. However, if an oxide-coated emitter has not ▶

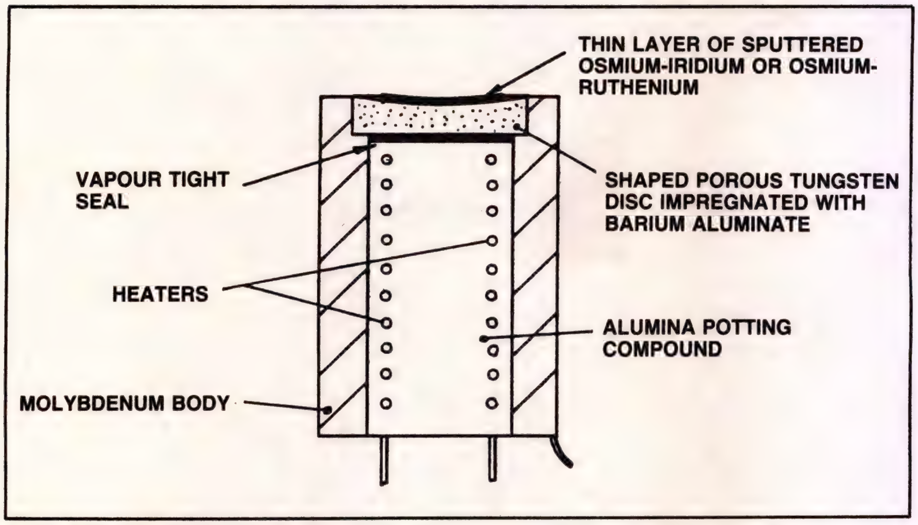
THIN LAYER OF SPUTTERED OSMIUM-IRIDIUM OR OSMIUM-RUTHENIUM
VAPOUR TIGHT SEAL
SHAPED POROUS TUNGSTEN DISC IMPREGNATED WITH BARIUM ALUMINATE
HEATERS
ALUMINA POTTING COMPOUND
MOLYBDENUM BODY

Figure 3: L Type dispencer cathode

reached its recommended operating temperature, an applied voltage can actually remove parts of the cathode coating. The advantage of purchasing a television set incorporating a stand-by heater for the television tube should now be obvious if one wants long life, as the application of a 25kV final anode voltage tube produces a reasonably strong field despite the twenty cm or so separation between final anode and cathode.

Although tubes using oxide-coated cathodes met the requirements of the market for many years, they were unable to meet the demands placed upon them by specific commercial, military and space technologies. There has been an increased demand for reliability, more output power and quick warm-up times. Space exploration and satellite communication systems demand reliability. Communications and radar systems need more power. Quick warm-up times are a desirable feature of equipment which may be left inactive for long periods and then required to cope with sudden emergencies.

The development of the modern dispenser cathode probably commenced with work done by the Philips Research Laboratories in about 1950. It was designed to overcome some of the short-comings of the oxide-coated cathode which included the difficulty of obtaining a homogeneous layer of oxide coating on the nickel base. Essentially its mechanical construction made it more suitable for use in specialised tubes, in particular those used for microwave amplification and generation, than the original simple oxide-coated cathodes.

The first dispenser cathodes were the so-called L-types which utilize emissions from a barium-tungsten system. Figure 2 illustrates the basic concept where a porous tungsten disc has a small plug of carbonate paste behind it. In valve pumping, which takes about two hours, the carbonate paste is reduced to an oxide form as in the case of the simple thermionic valve. Emission takes place from a thin layer of barium which seeps through from the reservoir of the barium and causes varium oxides to appear on the surface of the tungsten. However, as unwanted leakages of barium vapour were found to occur, and the activation and outgassing processes were difficult to control, the L-type cathode gave way to impregnated and mixed-metal cathodes.

The M-type cathode, shown in Figure 3, is constructed from porous tungsten which has been impregnated with barium calcium aluminate. During manufacture the emitter surface is coated with a thin metallic layer of osmium-ruthernium or osmium-iridium. As in oxide-coated cathodes, the emission of cathode current takes place from a thin layer of barium which continuously migrates to the surface from its reservoir within the porous tungsten.

A variant of the M-type cathode, called the mixed-metal cathode, was developed to avoid problems with the thin metallic coating which is susceptible to ion-bombardment and peeling effects. The solution was to incorporate metals within the porous tungsten block: various combinations such as tungsten and iridium or osmium tetroxide are used.

Stringent requirements are required of cathodes needed to support microwave links operating in space where long-life is of paramount importance. Figure 4 shows a typical space dispenser cathode which could be used for space applications considered for this requirement. Porous tungsten is used as the emitter with an appropriate barium oxide mixture behind it: activation and operation results in barium migrating through the porous tungsten to form a mono-atomic layer of emissive material on its surface. The tungsten disc may be shaped to meet particular applications.

New developments

The requirements of special military and space applications have placed more stringent demands on cathodes during recent years. there are ever-increasing demands for more power (higher emission per unit area of cathode), for quick warm-up times and, especially for space applications, a life of about five years. There are, however, some conflicting requirements. Life expectancy is a function of operating temperature, but so is emission current: long life is of paramount importance in space exploration, but would be of little value in a guided missile with an active life of perhaps minutes or even seconds. Contrary to what might be expected in the age of solid-state devices, research and develop-

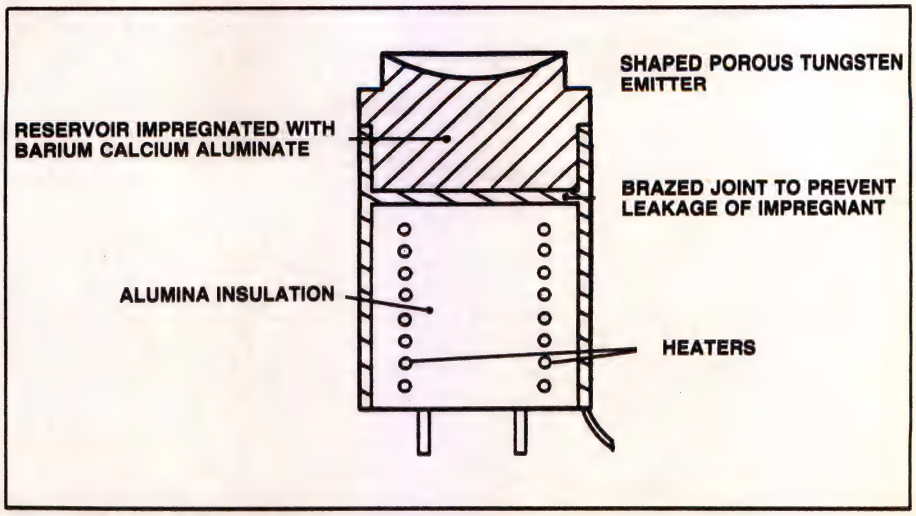
SHAPED POROUS TUNGSTEN EMITTER
RESERVOIR IMPREGNATED WITH BARIUM CALCIUM ALUMINATE
BRAZED JOINT TO PREVENT LEAKAGE OF IMPREGNANT
ALUMINA INSULATION
HEATERS

Figure 4: Simple space dispencer cathode

ment into improving the performance of the thermionic cathode is conducted at a high-level to meet the demands of microwave communications and display tubes.

In the last two decades there have been few advances made in the design of cathodes used in television tubes which are still based on the coating of a simple surface contained within a more complex supporting structure needed to focus and control the election stream. The nickel alloy sleeved oxide cathode is still industry standard although the construction has changed from one mounted in a ceramic support to an 'all metal' support. There have been improvements in materials and manufacturing techniques which have greatly extended the life of television (and display) tubes and tubes with warm up times measured in seconds have been developed. It would appear that the industry has a potentially reliable and relatively cheap device which meets the demands of the market, so if there has not been much pressure to develop new, more sophisticated, cathodes and supporting structures. Where cathode loadings are very high, such as in projection tubes, dispenser cathodes are now being introduced.

IBM has just released details of a new integrated multi-beam thermionic cathode for cathode ray tubes; an array of minature electrodes are fabricated from thin metal films on a sapphire substrate with the microcathodes being made lithographically using carbonate paste and photoresist.

Acknowledgement
The author is indebted to Thomas Electronics of Australia Pty Ltd, IBM and Hewlett-Packard, for up-to-date information on progress and materials used in cathode ray tubes. ●

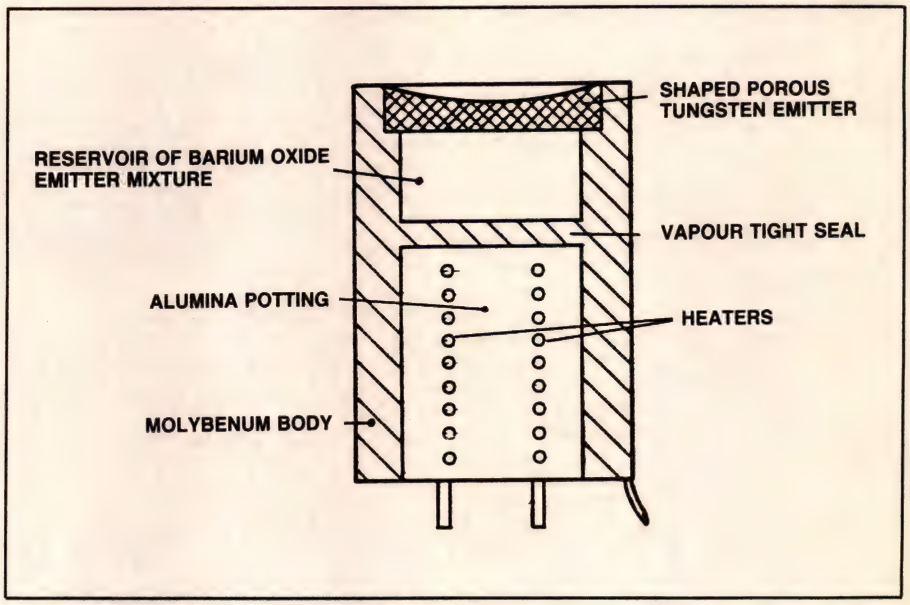
SHAPED POROUS TUNGSTEN EMITTER
RESERVOIR OF BARIUM OXIDE EMITTER MIXTURE
VAPOUR TIGHT SEAL
ALUMINA POTTING
HEATERS
MOLYBENUM BODY

Figure 5: Advanced dispencer cathode for space applications

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The Marantz CD 94

Marantz is fighting its lo-fi image with a range of very upmarket product which, it hopes, will turn the company's flagging fortunes around.

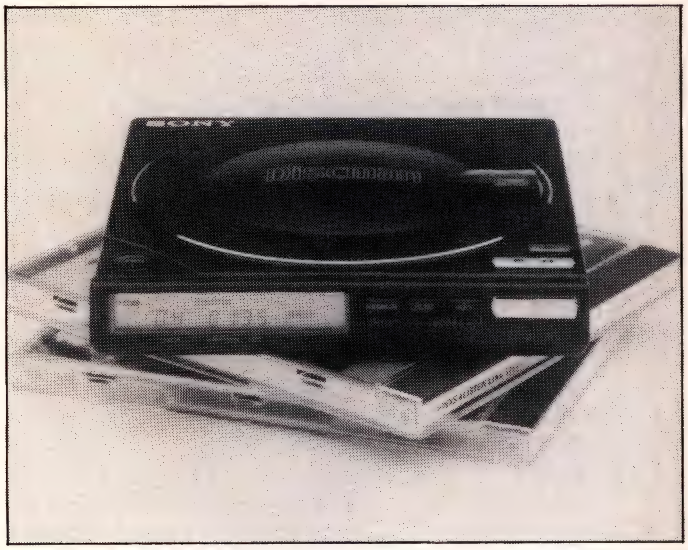
Ken Ishiwata, Marantz's best designer has been working on the new CD 94 for the last eight months, and following its release, he has been receiving many and varied accolades for his role in the development of the CD 94.

At a press conference to announce the release of the CD 94, Ishiwata said that one of the companys main aims in the design of this unit was to deal with the problem of eddy current. This was accomplished by dipping the chassis in a copper bath to create a superior ground path. Double thickness copper was used throughout the circuit boards to lower signal path resistance. Crosstalk has been minimised by devising totally independent signal paths from input to output.

As regards circuit design the Marantz CD 94 has four independent regulated power supplies for the various electro-mechanical, digital analogue and display circuits. Left and right channels are totally separate circuits throughout.

Among the many features of this unit are an 'Automatic Music Search (AMS) and 'Favourite Track Selection (FTS) which allows the user to program his or her favourite tracks from disc into the player's memory. This memory will remain even if the unit is unplugged.

Altogether it is claimed that the stereo imagery of the CD 94 is particularly good largely on account of the low noise performance and its 'vivid' separation.



Enter the Discman

Sony have developed a new portable compact disc player the D-100 to follow up on the success of its other CD units. It claims that this unit is no less than 80% smaller than the original and weighs around 420 grams.

Apparently the D-100 is more than a portable music machine. In fact it's a testament to Sony's commitment to CD technology. With such grand sentiments inherent in the make-up of this device one would naturally expect great things from the D-100. Sony claims that it delivers.

One interesting feature built into the D-100 is a digital filter that prevents jitter generation and suppresses unnecessary residual signals. It also features an 'inbuilt track memory' which if the player should be disturbed by earthquakes, civil war etc will return it to the precise playing position when 'normality' has been restored.

TDK's Rolls Royce

TDK claims that its MA-XG is 'unquestionably the finest tape in the world' and states that it can back its fightin' words with 'facts'.

The MA-XG is a metal (type IV) position cassette, using the TDK developed pure iron particle 'Finavinx'. Finavinx has 'four times the magnetic energy of high postion tapes'. It can also apparently store four times the information of any other type of tape.

The sensitivity figure of the MA-XG stands at −20dB and the noise level rates −61.5 dB. This tape is claimed to have a large dynamic range which makes level settings during recording not as critical as would otherwise be the case.

Digital Solarization

Anyone who wants to know the effects of Digital Solarization would be advised to buy the new HR-D57OU Digital Video Recorder from JVC. Apparently Digital Solarization is 'something akin to an electronic paintbrush' whatever that might mean.

In addition to this marvel the new recorder also features a Digital Freeze which will freeze action while recording or watching a regular TV broadcasdt, a Strobe Effect which gives a 'time lapse' effect as well as a Hi-Fi dynamic range of more than 90 dB. With all these attractions it is difficult to see how the HR-D57OU can fail to be a winner in the marketplace.

The Portable Dictator

Sony have released the TCM-R1, a mono cassette recorder aimed at the educational market. It uses large scale integrated circuitry and has a built-in ic memory so that the last four or eight second segment to be played back can be repeated 'immediately and endlessly'.

Sony reckon that this function is particularly useful 'when learning the phraseology of languages'. As a consequence the company belives that this unit will appeal to 'speech therapists, music and drama teachers and university students though the latter might baulk at the $249 price tag.

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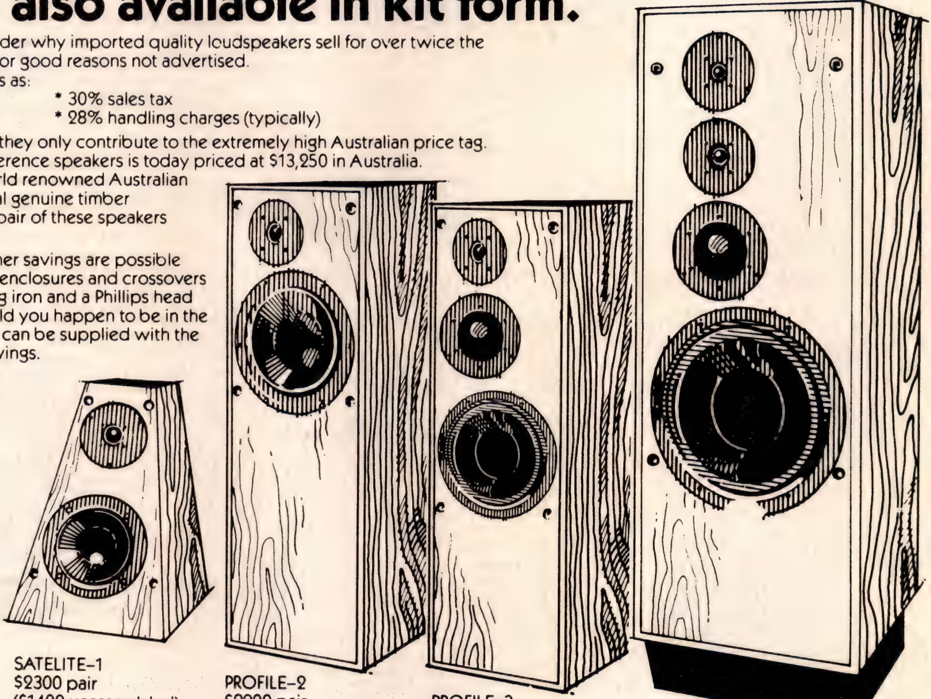

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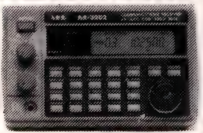

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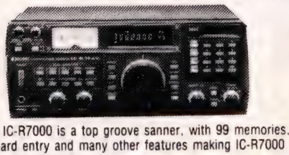

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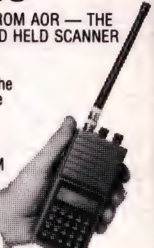

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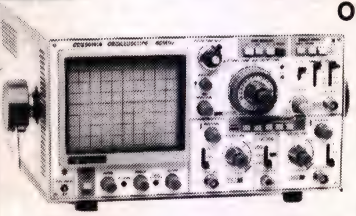

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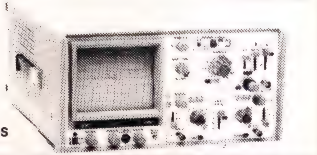

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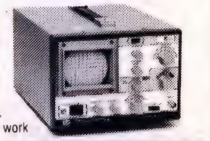

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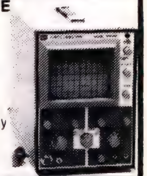
GOS-955



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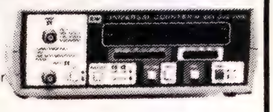

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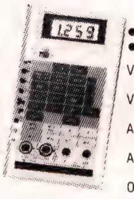

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100 μV max resolution, 0.8%
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LCR METER Escort ELC 123

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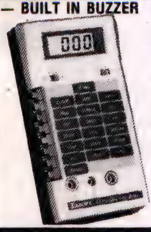

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ANALOGUE MULTIMETERS

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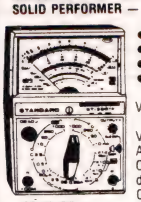

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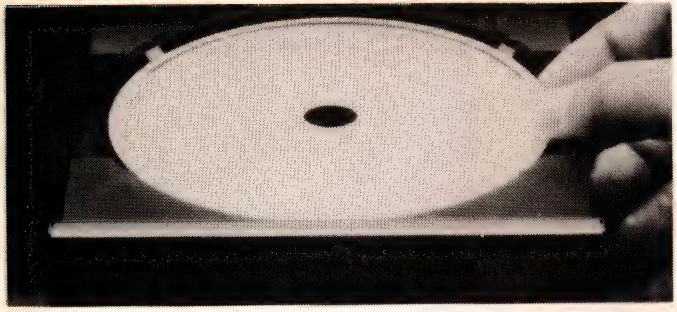

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THE LATEST IN SPECTRUM ANALYSIS

Hewlett Packhard has just released a new spectrum analyser in Australia. It's the model 8590A, and HP expect it to set the world on fire.

Jon Fairall

MOST readers will be familiar with the idea of time domain displays, ie: an electrical signal seen in relation to time. A typical example is a sine wave displayed on an oscilloscope. However, the time domain is not the only way to look at electrical signals. The frequency domain is just as valid. This takes an incoming waveform, no matter how complex, and divides it up into discrete frequency components. In a frequency domain graph, the vertical axis is amplitude, and the horizontal one is frequency.

Why bother? Potentially, the frequency domain is useful in a whole range of areas where ac signals are being produced. It can give information about the output of oscillators, filters, mixers, amplifiers and so on that would be extremely difficult to obtain by studying time domain displays. This is especially true where more than one frequency is present as is often the case in the real world. At a glance a spectrum analyser can tell you about frequency, harmonic content, modulation, filter sharpness and noise levels.

The basic instrument for frequency domain analysis is the spectrum analyser. The most common form of analyser design is very similar to a radio, in as much as a conventional superhetrodyne architecture is used to select a single frequency and display its amplitude (See Figure 1). The trick is that a variable signal is fed into the mixer section, so that the frequency selected for display ramps up from a low frequency to a higher one. This is called the span. Usually it's done by feeding a sawtooth waveform into the local oscillator. If things are so arranged that the same signal is applied to the horizontal axis of a display, a graph of frequency against amplitude is the result.

Hewlett-Packard's HP8590A is a good example of what can be expected in a modern, top of the line version of a spectrum analyser. Although the basic architecture is conventional, it comes equipped with all the extra accuracy and user features that digital control make possible. It was released on the Australian market in late 1986.

A quick look around the front panel gives some idea of what to expect. One of the great things about this machine is that the operation of the front panel is intuitive once you know what the machine is supposed to do. Since many machines are not so easy to operate, HP deserves a pat on the back for ergonomics, if nothing else.

There is a smallish but adequate CRT display to the left of the front panel. As well as showing the trace, a graticule and all the information necessary to interpret the display is included on the screen. Down the right hand side of the display is a series of labels for the sort-keys. These show the current function of the six buttons on the side of the display.

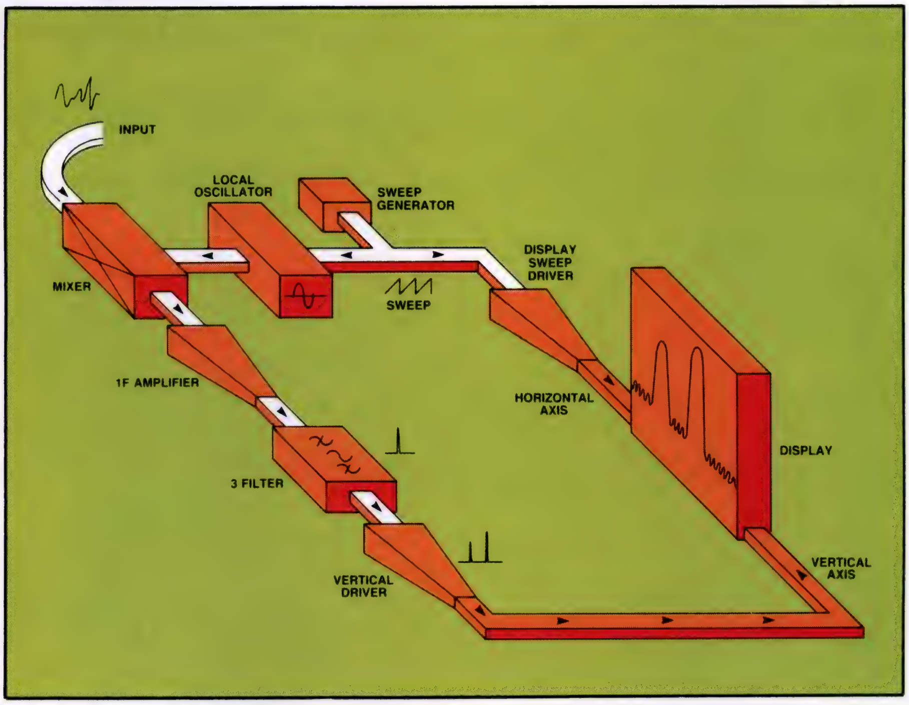
The front panel controls are grouped in a number of logically coherent areas. Bottom right is a keypad for entering digits. Top centre are three buttons for the fundamental operating parameters of the machine: frequency, amplitude and span. Below is a big knob which can be turned to tweek any value held on the display. Top right is a series of buttons to alter the basic operating mode of the machine, and immediately below a set of controls for the markers. These are cursors which can be moved to any place on the trace to register the value in frequency and amplitude of a particular artifact.

To find out the way the 8590 works I connected it to an old HP rf signal generator, which was lying on the work bench. The first thing to do is to connect a fifty ohm lead to the input socket and to ensure that you match impedances at both end of the line. If you don't, at best you find the 8590 refusing to work, and at worst you will load the circuit under test, possibly breaking it.

Having got that straightened out, switch on. The machine jumps into the present mode, which gives you a very wide sweep from a few megahertz up to almost a Gigahertz. To narrow things down so as to centre on the frequency of interest, press the Frequency button. The softkeys on the screen display a number of options, including one for setting the centre frequency. This is the frequency at the centre of the screen, and if you know what you are looking for, can be entered from the keyboard. Alternatively, if you don't know what frequency you want, but can see a signal on the trace, you can use the knob to shift it until it's more or less centred.

Once this is done, you select Scan, and a new menu appears under the soft-keys. This will allow you to set the frequency at the extreme left and right of the display. In this way you can get the display to show you the exact region you are looking for.

Finally, pushing the amplitude button will allow you to configure the machine for the strength of the incomming signal. The soft-key menu allows you to select the value of the attenuator on the input of the machine, so that the signal is a manageable size, change the value of the top line of the display, change the vertical scale of the screen, and switch it from log to linear.



Spectrum Analyser Layout

At this stage the signal should be more or less centred and any harmonics or other features of interest should be within the screen. It's now possible to make readings by selecting the Marker button. This brings up another soft-key menu which allows you to move a small cursor onto any point on the trace and measure its position. It also allows you to measure the difference between any two artifacts on the screen with a delta marker. This is particularly interesting when looking at harmonics.

There are a number of things that can be done to increase the clarity of the display, and it's in the control of these that the operator gets his money's worth. For instance, the selectivity of the analyser is set by the bandwidth of the if stage. Selectivity is a measure of the ability of the machine to resolve two frequency components very close together. The narrower the bandwidth, the better the resolution. Also, the narrower the bandwidth, the less the noise that is admitted. On the HP, this is selectable by changing the 'resolution bandwidth'. The weakest signal that can be measured is defined by the amount of noise on the trace. If making the resolution bandwidth narrow does not help enough, a further stage is to apply the video filter, a post detection low pass filter that averages random noise and fluctuations. Another useful function is signal track, which allows one to keep a signal in the centre of the screen as you zoom in or out on it. This zooming function is accomplished with the span button.

One problem that becomes important in manufacturing situations, where the same test must be done over and over again, is that it can take quite a while to set the machine up. there are a couple of ways around this. It's possible to store the position of all the knobs in non volatile memory, so that a single button will reconfigure the machine as required. Another option is to program it over an instrument control bus like HPIB or from a computer using RS232. The situation can also be turned around, so that you can send the results of experiments down the line, either plotting out a copy of the display or receiving back the values of the markers.

At $19,000 the HP8590 is not for everyone. However, if you have a need for high quality spectrum analysis then this one is certainly worth looking at. According to Hewlett Packhard, it's under consideration by the RAAF, Telecom and other like minded bodies. It should do well. ●

Specs at a glance

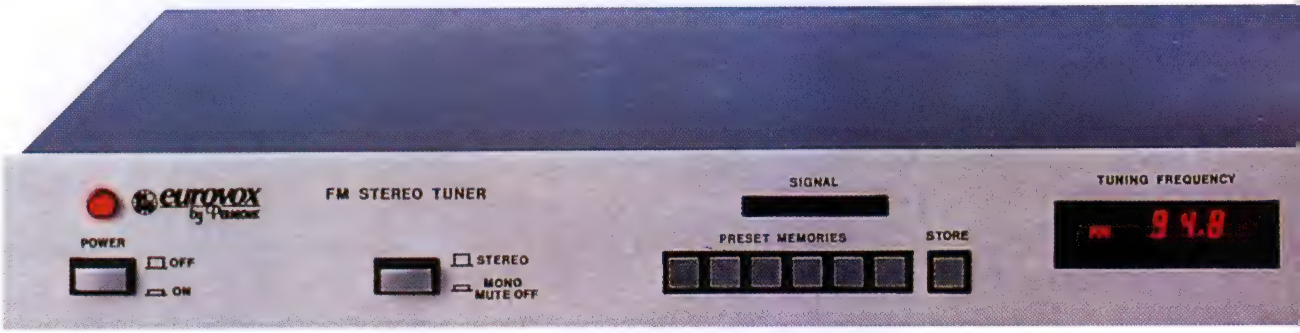
Frequency range: 10 kHz-1.5 GHz
Frequency accuracy 5 MHz +1% of span
Amplitude Range −115 dBm to +30 dBm
Noise Level: <15 dBm

REVIEW

THE KIWI THAT ROARED

The Perreaux company of NZ has produced a fine FM tuner. What it can do it does well it's what it can't do which worries Louis.

Louis Challis



When Eurovox, one of Australia's leading car radio and mobile sound system designers decided to act as agents for Perreaux of New Zealand, a number of people sat up and took interest. One could be easily excused for thinking that these two large and well-respected organisations do not really have all that much in common.

Eurovox have developed a range of mobile car radios and cassette players which are positively 'avante garde' and which offer an ergonomic functionality, performance and appearance which I suspect is the envy of most of their competitors. Having reviewed a number of their products, I have been very impressed with what they have designed and, more importantly, with what they have produced.

Perreaux's factory is located at Napier in the 'Shaky-Isles' and over the last six years they have built up an international reputation for manufacturing high quality consumer and professional electronic equipment which has always placed the emphasis on quality without regard to price.

An FM tuner produced by Perreaux which doesn't incorporate an AM section, which is then marketed by Eurovox, sets me back on my heels. You ask why? Well, two years ago Eurovox had already developed a combined AM/FM stereo front end for their car radios which was and still is top of the class and which offers an AM component which is head and shoulders in front of most of their competitors. As a consequence the concept of trying to market an FM stereo tuner, without AM in this country, worries me and I suspect would also worry most of you intending purchasers who would then undoubtedly ask the question 'What am I getting for my money?'

The Eurovox by Perreaux Model EU1 FM stereo tuner retains the same basic modular footprint that the rest of the Perreaux units currently display. As a consequence of it's large footprint it only really integrates well with other Perreaux equipment, although it will fit into a 19 inch rack, provided you've got a shelf to support it on.

Appearance

The front is finished in brush satin aluminium with neat dark grey silk screen lettering to label the functional controls, which are to say the least, somewhat sparse. At the left hand end of the front panel is a POWER ON/OFF push button switch with a small LED directly above. To the right is a STEREO/MONO MUTE switch. When in the stereo mode and whilst tuning between stations you have effective muting, whilst in the mono mode you can hear every bit of hiss or low level signal which the front end of the tuner can capture. In the centre of the panel are six PRE-SET MEMORY buttons with a separate STORE button which retains the memories, but only while the power is connected. You immediately lose the stored reference signals once you disconnect the mains plug. Flanking the top of the pre-set memory buttons is a five segment LED display to indicate the incoming signal strength. On the right hand side of the panel is a four digit tuning frequency display which covers the range 79.9 MHz to 107.9 MHz in 100 kHz steps and also displays stereo when tuned to a stereo station and ME for memory when the memory button is activated. At the right hand end of the front panel is a reasonably large rotary knob with indents whose continuous rotation allows you to tune up or down the frequency dial in precise 100 kHz steps.

EUROVOX BY PERREAUX FM STEREO TUNER

Dimensions:	**432 mm (wide) x 345 mm (deep) x 48 mm (height)**
Weight:	**4.5 kg**
Manufactured by:	**Perreaux, Napier, New Zealand**
Marketed by:	**Eurovox, Australia**
Recommended Retail Price:	**$1,097**

Rear Panel

The rear panel is even more sparse than the front panel with a 75 ohm co-axial socket for connecting your FM antennas, a pair of gold plated RCA co-axial sockets for your left and right channel signal outputs and a selectable de-emphasis switch to select 25, 50 or 75 microsecond de-emphasis characteristics depending on where the unit is being used. In New Zealand, Australia and Europe the 50 microsecond central position

is appropriate, whilst in Canada and USA most of their FM signals are encoded with a 75 microsecond pre-emphasis. The 25 microsecond de-emphasis value is designed to suit a small number of US stations which utilise this value in conjunction with a Dolby B noise reduction (encoding) system.

Inside the unusually large packing container the manufacturers have provided simple (and not entirely suitable) 'rabbit's ear' antennas. This allows the new purchaser to put the unit into immediate operation, although I feel that this approach may well be counter-productive as it only tends to encourage the viewpoint that this type of antenna is all that is really necessary to receive adequate signals, even in a high signal strength area.

Internal Design

On removing the cover from the unit I was not altogether surprised to find that the sparse front panel and back panel characteristics also seem to have been adopted by the circuit designers. At the rear left hand side of the large well made and clearly labelled mother board are two separate power supplies for the positive and negative supply voltage rails. These are flanked by a neat array of rectifiers, regulators and capacitors with maximum physical separation being provided from the tuner circuitry which is all located on the right hand side of the same board. The tuning circuitry occupies only about 15 per cent of the circuit board's space and is all located at the rear right hand corner. Apart from the RF and IF stage which incorporates mosfets and varicap tuning elements in a neat imported Japanese module, the rest of the RF tuning system is limited to three linear integrated circuits and an array of tuning coils and filters. The design of this front end is based on a wide band quadrature detector and phase locked loop to achieve minimum phase shift and minimum harmonic distortion. These characteristics are only achieved provided you are correctly tuned to the required station and provided it has adequate signal strength. The rest of the circuitry at the front of the mother board consists of five integrated circuits and associated diodes, resistors and capacitors. These components which are all associated with the memory function and digital display account for almost half of the active components on the board. The metal cabinet is well fabricated from heavy guage steel and the unit has been designed for operation without supplementary ventilation, or it would appear, without special cooling requirements.

MEASURED PERFORMANCE OF EUROVOX BY PERREAUX EU1 FM STEREO TUNER

SERIAL NO.	P13345
F.M. SECTION	
TUNING RANGE	
	87.9 - 107.9 Hz
INPUT IMPEDANCES	75 ohms ONLY
OUTPUT LEVEL @ 1 kHz	400 mV
(40 kHz Deviation)	
FREQUENCY RESPONSE	
(Includes Generator Response)	Below 10 Hz - 15 kHz
CHANNEL SEPARATION	
(Includes Generator)	
Left into Right	37 dB
Right into Left	46 dB
DISTORTION @ 1 kHz	
(Includes Generator)	
Deviation = 40 kHz, INPUT LEVEL =	65 dBf
	0.12%
USABLE SENSITIVITY	
(40 kHz Deviation)	
Mono for 26 dB Signal to Noise Ratio	45dBf
Stereo for 46dB Signal to Noise Ratio	18.0dBf
MAXIMUM SIGNAL TO NOISE RATIO (65 dBf)	
Mono	73 dBA
Stereo	70 dBA

The objective evaluation of the tuner confirms that it provides excellent performance. The frequency band width displays a very smooth frequency response which is almost ruler flat from 10 Hz to 15 kHz ± 1 dB.

The channel separation is better than 37 dB from left channel to right channel and better than 46 dB from right channel to left channel. The usable sensitivity for 26 dB signal noise ratio in the mono mode is 4.5 dBf and for 46 dB signal to noise ratio in the stereo mode is 18 dBf which may be regarded as excellent performance and certainly good enough for outer fringe areas. The maximum signal noise ratio is 70 dB(A) in the stereo mode and is at least 73 dB(A) in the mono mode. The distortion with 40 kHz deviation and a 56 dBf signal level is less than 0.12 per cent in the mono mode which is really excellent and a credit to the designers. Taken overall my measured performance results agree very well with the manufacturer's published figures and confirm that this is an excellent FM stereo tuner.

Objective Tests

I connected the tuner up to a Eurovox by Perreaux EX1 dual channel Class A preamplifed and an EXP1050 dual channel power amplifier with the outputs being fed to a pair of B & W 801F speakers. With the rabbit's ear aerial connected to the input I had no difficulty in picking up every FM station in Sydney whose presence I had previously been aware of, together with three TV stations and thre new FM stations. With the rabbit's ear connected, and even with the correct 50 micosecond de-emphasis selected, the quality of the sound seems to lack 'something' which I had some difficulty identifying. When I reverted to a proper FM aerial, thereby avoiding the obvious front-end mismatch from what is effectively a 300 ohm antenna being connected to a 75 ohm unbalanced input the initial subjective problem immediately disappeared. With a proper aerial connected, the quality of the sound was generally good and I suspect just about as good as the source material would allow. I soon became aware of ▶

AM TRANSCEIVER

(Continued from page 74)

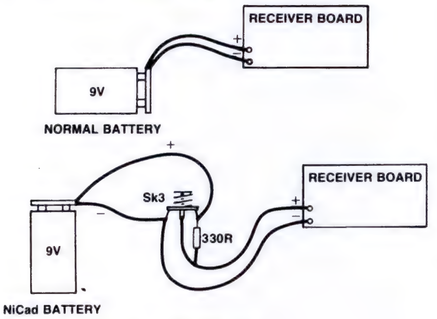


Figure 6: Battery Connections

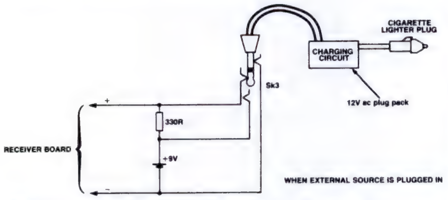


Figure 7: Switching action of socket SK3 for charging battery and powering up the unit from external source.

BATTERY CONNECTIONS

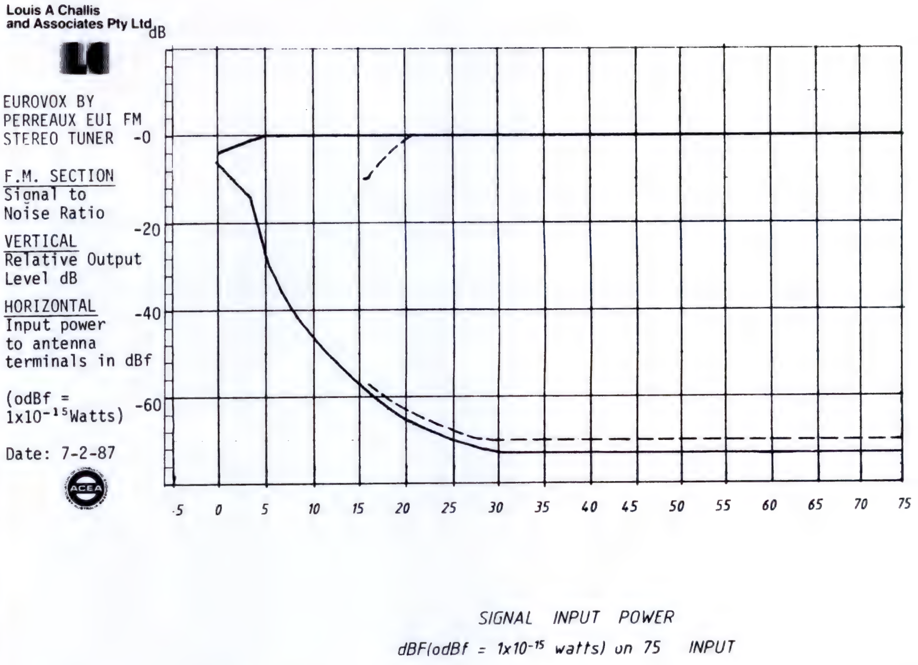
The battery connections are not included on the circuit diagram. This is because there are two variations, depending on how you want to configure the unit. If a normal 9 V PP3 battery is used, the centre taps of the switch SW1 should connect directly to a battery clip. Care must be taken here to avoid the fatal mistake of connecting the battery to the circuit with the wrong polarity. Note that since external charging is not necessary, you do not need to drill hole i in the side panel.

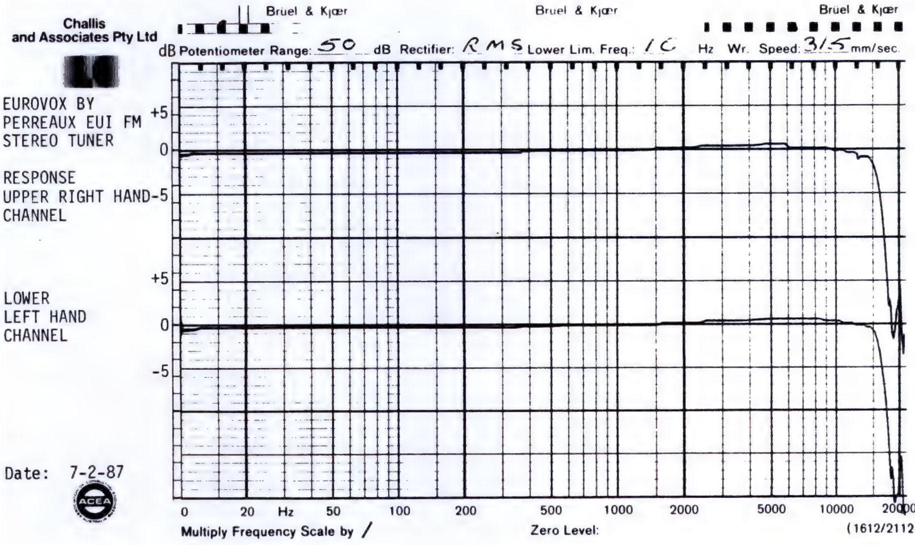
Alternatively, a rechargeable 9 V NiCad battery can be used. I obtained one from Hi-Com Unitronics which is the same size as a normal 9 V PP3 battery. The capacity of this NiCad is slightly less than a normal 9 V but that's not a problem as it can be recharged as often as necessary, either from a 12 V battery or via the mains.

To allow external charging, hole i is drilled on panel C for mounting a 3.5 mm phono socket (SK3). Figure 6 shows the actual connections with a normal and a NiCad battery. Socket SK3 has a switching action as shown in Figure 7. Normally when nothing is plugged into the socket, the 9 V NiCad will directly power the circuit and the 330R resistor is redundant. With the 3.5 mm jack plugged in, the battery is charged through the current limiting resistor. The external source will also power the circuit if it is turned on via the toggle switch SW1. This is a rather handy feature since the unit can be operating while the battery is being charged.

From Figure 7, some readers will have detected that during battery charging, the circuit is powered by external 12 Vdc instead of the usual 9 V from the battery. This is not a problem, in fact the unit works better. The unit will work with a supply varying between 7 and 15 volts. Nine volts was picked simply because of its convenient size. A 12 V supply to the circuit would only increase the output on the transmitter and hence operate with a better range.

PERREAUX TUNER





the extend to which some of the local FM stations are still utilising old and I suspect worn out micro-groove records replete with clicks, pops and scratches. This leads me to wonder why would so many people wish to listen to FM stereo radio. During the course of the three months that I had the EU1 FM stereo tuner I came to appreciate its smooth uncoloured sound on the better stations and most certainly became aware of the extent of dynamic compression being applied by a number of well known popular FM stations who happen to be positioned around the top of the band.

Criticism

My only criticism on the operation of the EU1 Fm stereo tuner relates to one's ability to mis-tune stations by as much as 100 kHz (off centre frequency) in the mono unmuted mode. All of its other ergonomic characteristics are excellent and unimpeachable.

The Eurovox by Perreaux FM stereo tuner is well designed and generally excellent unit, but one which I believe is out of touch with what the market place really requires. Without an AM stereo tuner system, irrespective of how poor that AM signal quality may be, the market place is unlikely to accept this unit in any significant numbers. Eurovox know how to both manufacture and equally importantly how to market quality stereo AM. I feel sure that given the market's response to this unit that they will soon replace the current generation EU1 by a very much more worthy successor. ●

SPECTACULAR

RATED POWER: 500 watts RMS per channel – both channels driven into 8 ohms from 20 Hz to 20,000 Hz at no greater than 0.09% THD from .25 watts to rated power. 1000 watts driven into 4 ohm speaker load on each channel.

DISTORTION: 0.09% THD and IM under any and all conditions prior to clipping. The distortion is virtually all, even order harmonic and will not become irritating even well into clipping.

OPEN LOOP FREQUENCY RESPONSE: – 6 dB at 120,000 Hz. This is the amplifier's frequency response prior to correction of the signal.

WEIGHT: 30kg (66lbs)

CHANNEL SEPARATION: 20 Hz to 20,000 Hz, greater than 60 dB.
HUM & NOISE: 80 dB below rated output, 20 Hz to 20,000 Hz unweighted

DAMPING FACTOR: 200 at 50 Hz.

SLEWING RATE: 55 volts per microsecond (of output stage after the RF Filter).
INPUT IMPEDANCE: 10K ohms balanced. This is in accordance with international standards. A low input impedance is provided to minimize interaction with interconnect cables.

BALANCED INPUT SENSITIVITY: 0.77 volts RMS for rated output at 1,000 Hz.

BANDWIDTH: ± 0.25 dB from 20 Hz to 20kHz.
– 3 dB 5 Hz and 50kHz
The response of – 3 dB is deliberately created by means of a filter in the balancing circuit, to reduce the possibility of RF break through

PHASE RESPONSE: + 2° at 20 Hz
– 2° at 20,000 Hz
This phase accuracy is to present a proper soundstage in width and depth.

LEVEL CONTROL: Separate level controls are provided for each channel using high quality stepped attenuators of sealed construction.

VARIABLE REFERENCE METERS: Calibrated – 24 dB to 0 dB in 3 dB steps and Clip. Displays ACTUAL power available with respect to mains voltage and load impedance.

CANNON CONNECTORS: Cannon type connectors are provided for the input and output signals.

BALANCED INPUT: Input balancing is achieved by means of an active circuit which provides better audio quality than some transformers, making this amplifier well suited for Recording Studios.

RACK MOUNT: The 8000C Amplifier is designed for standard 19″ Rack Mount and is 4 units high.

DIMENSIONS:
Height 177mm/7″/4u
Width 483mm/19″
Depth 447mm/17⅝″

PERREAUX PROFESSIONAL POWER AMPLIFIER MODEL 8000C

POWER OUTPUT: 180 watts RMS per channel at clipping into 8 ohms. 260 watts RMS per channel at clipping into 4 ohms. 400 watts RMS bridged into 8 ohms.

MAXIMUM CURRENT OUTPUT: 16 amps.

MAXIMUM VOLTAGE SWING: 113 volts peak to peak.

DISTORTION: 0.06% THD and IM under any and all conditions prior to clipping.

AMPLIFIER BANDWIDTH: 0.1 dB from 10 Hz to 20,000 Hz. 3 dB from 2 Hz to 300,000 Hz.

PHASE RESPONSE: + 2° at 20Hz.
– 2° at 20,000 Hz.

RISE TIME: Typically 1 microsecond.

CHANNEL SEPARATION: 60dB or better 20 Hz to 20,000 Hz.

HUM AND NOISE: 80 dB below rated output, 20 Hz to 20 kHz unweighted.

DAMPING FACTOR: Over 200 from 10 Hz to 1,000 Hz.

INPUT IMPEDANCE: 47,000 ohms.

INPUT SENSITIVITY: 1.55 volts RMS.

DIMENSIONS: 483 mm (19″) wide.
133 mm (5½″) high.
356 mm (15″) deep.

WEIGHT: 15kg (33lb).

All specifications subject to change without notice.

PERREAUX PROFESSIONAL POWER AMPLIFIER MODEL 3000B

Perreaux®
Australia

PERREAUX AUSTRALIA
A division of Eurovox United Pty Ltd.
6 University Place, Clayton, Vic. 3168
Phone 561 5244

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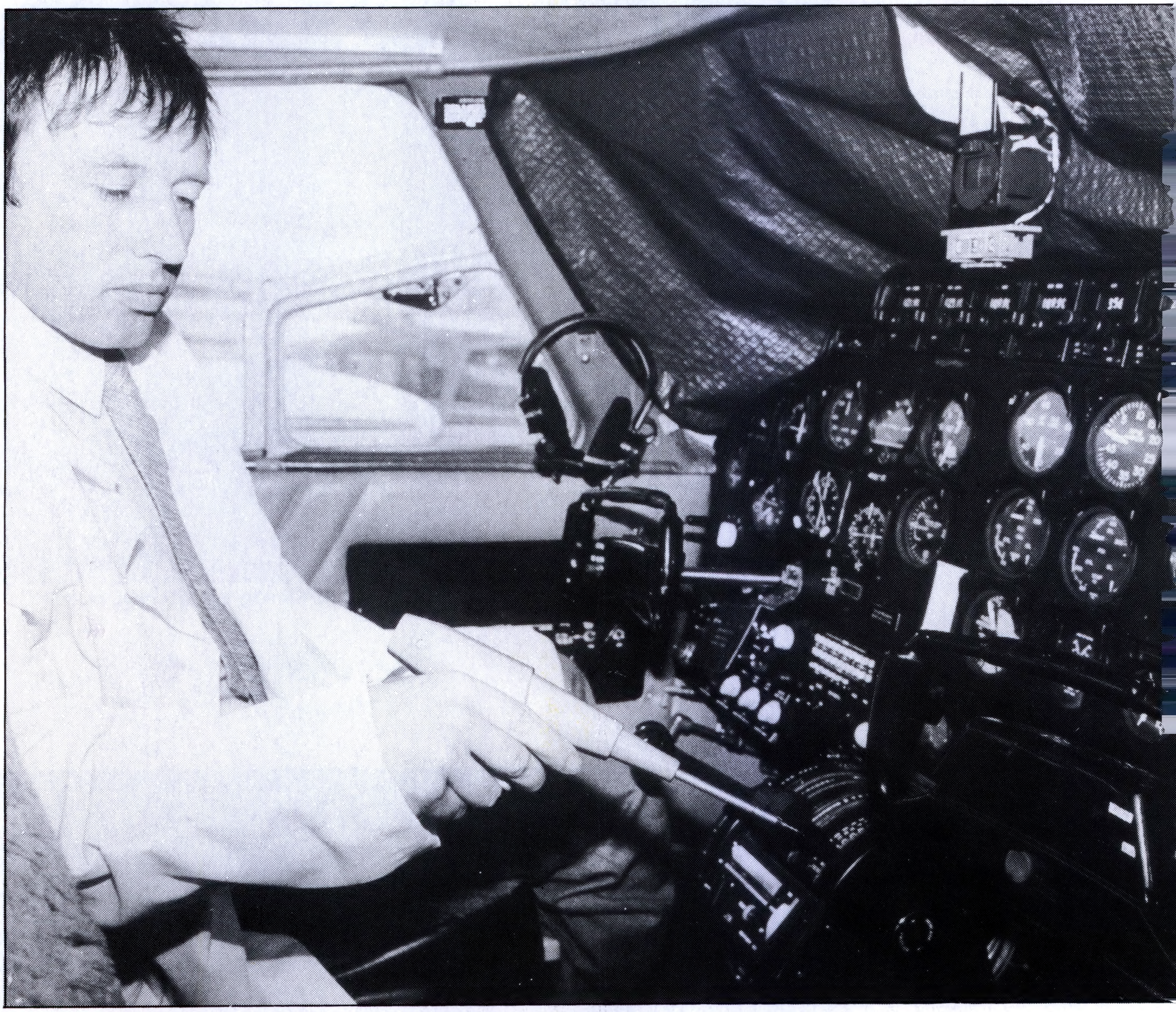


Security at Australian airports is nothing if not meticulous.

The Watch and the World

The world today is faced by some of the greatest challenges in its history. Wars, plagues and famines are ravaging virtually every continent as never before. Many hope to find the answers to these international ills in technology and here in Australia Patrick W. K. Won has risen to the challenge. Casting their eyes about them Mr Won and his import company saw where they could make a valuable contribution to the wellbeing of the nation.

With lavish press releases they announced their find to the national media. We at ETI consider ourselves fortunate and privileged to have received one of these documents. Now, what is this wondorous item which is going to make such a change to our lives, prepare yourself for a shock, it is none other then the famous PROTIME watch, the ONLY watch in the world which combines a digital timepiece with a cigarette lighter. For all you cynics 'the Protime watch isn't just a watch it's a "state of the art electronic masterpiece". Mr Won points out that this device is 'indispensible to the smoker who is always losing his lighter'. With such entrepreneurs as Mr Won at the rock face of industry it surely cannot be long before the Australian economy begins its long awaited boom.

Dog story

In the last edition of ETI we featured a Mutt Minder. As you will recall this device was intended to deter savage hounds from eating ETI readers and decreasing our circulation thereby. This device, an ETI exclusive seems to have been trumped by the Japanese. Earlier this year a Japanese company announced it had also invented a 'dog deterer'.

This gadget is fixed to the animal's collar and is designed to administer a mild electric shock to the offending beast when it barks. Like the Mutt Minder this device could either calm the dog down or enrage it with pain. So it could either preserve your life or take it depending on your luck. We prefer the non tech device of running.

SIEMENS

Switch on the future with Siemens relays

Siemens relays are at the heart of many technological advances.
Particularly within the automotive industry where Siemens electromechanical relays contribute to outstanding improvements in safety, fuel economy, convenience and pollution reduction.

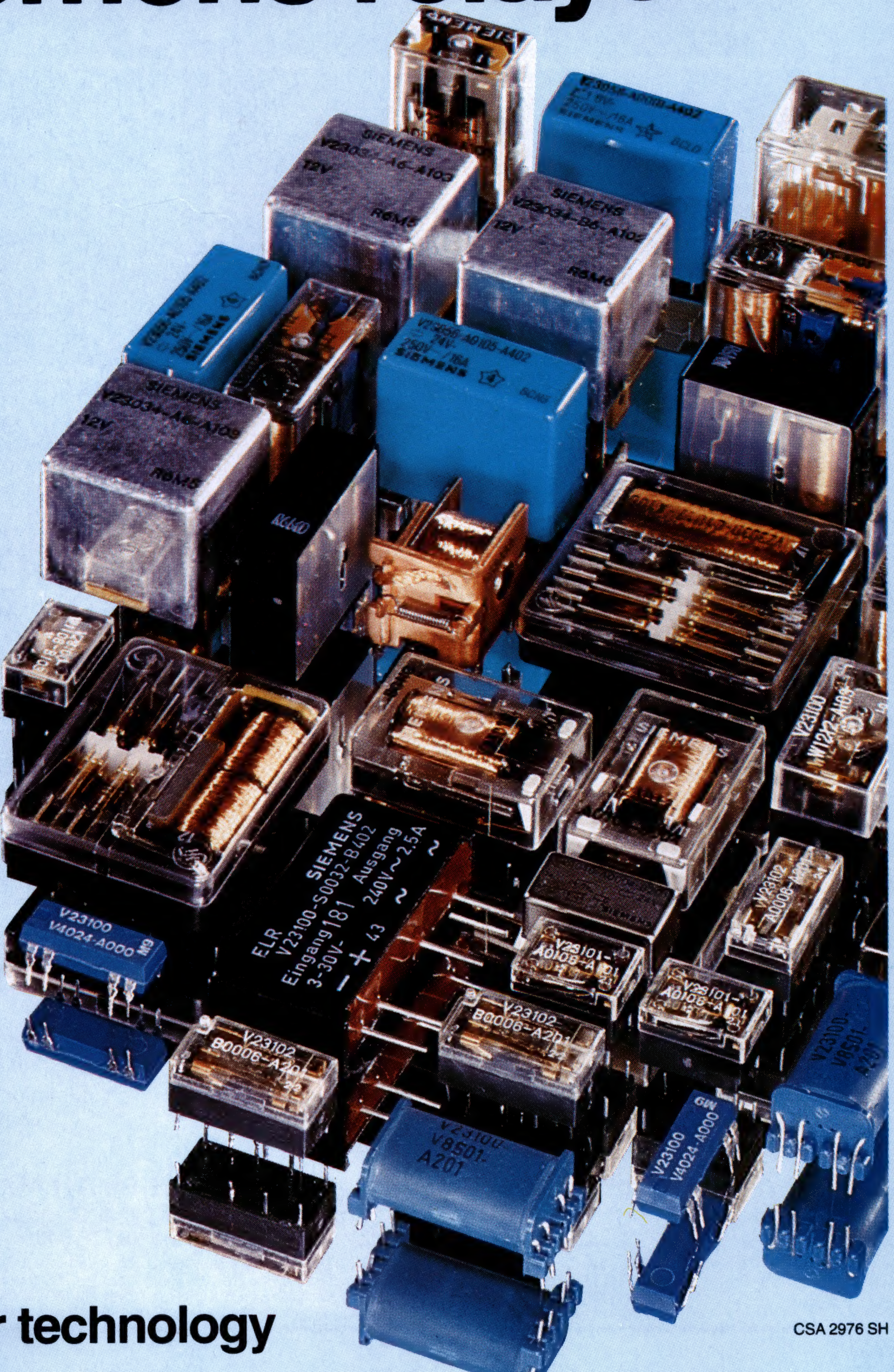
That's because of their reliability, economy, compact size, sturdiness, efficiency and low resistance in the contact circuit.

And Siemens has an extensive range of relays for every application. Including solid state relays, which offer significant advantages such as high switching rate, long life, bounce free switching, low spark generation and non inductive input resistance.

Furthermore, Siemens higher technology is currently developing other superior relays which are even more efficient, more reliable and more compact.

And which are switching on the future.

For more information, contact your nearest Siemens office.



Siemens Ltd.
544 Church Street, Richmond, Vic.
Melbourne: (03) 420 7308 Sydney: (02) 436 8730
Brisbane: (07) 369 9666 Perth: (09) 362 0123

Distributors
Victoria: Promark Electronics (Vic) (03) 878 1255
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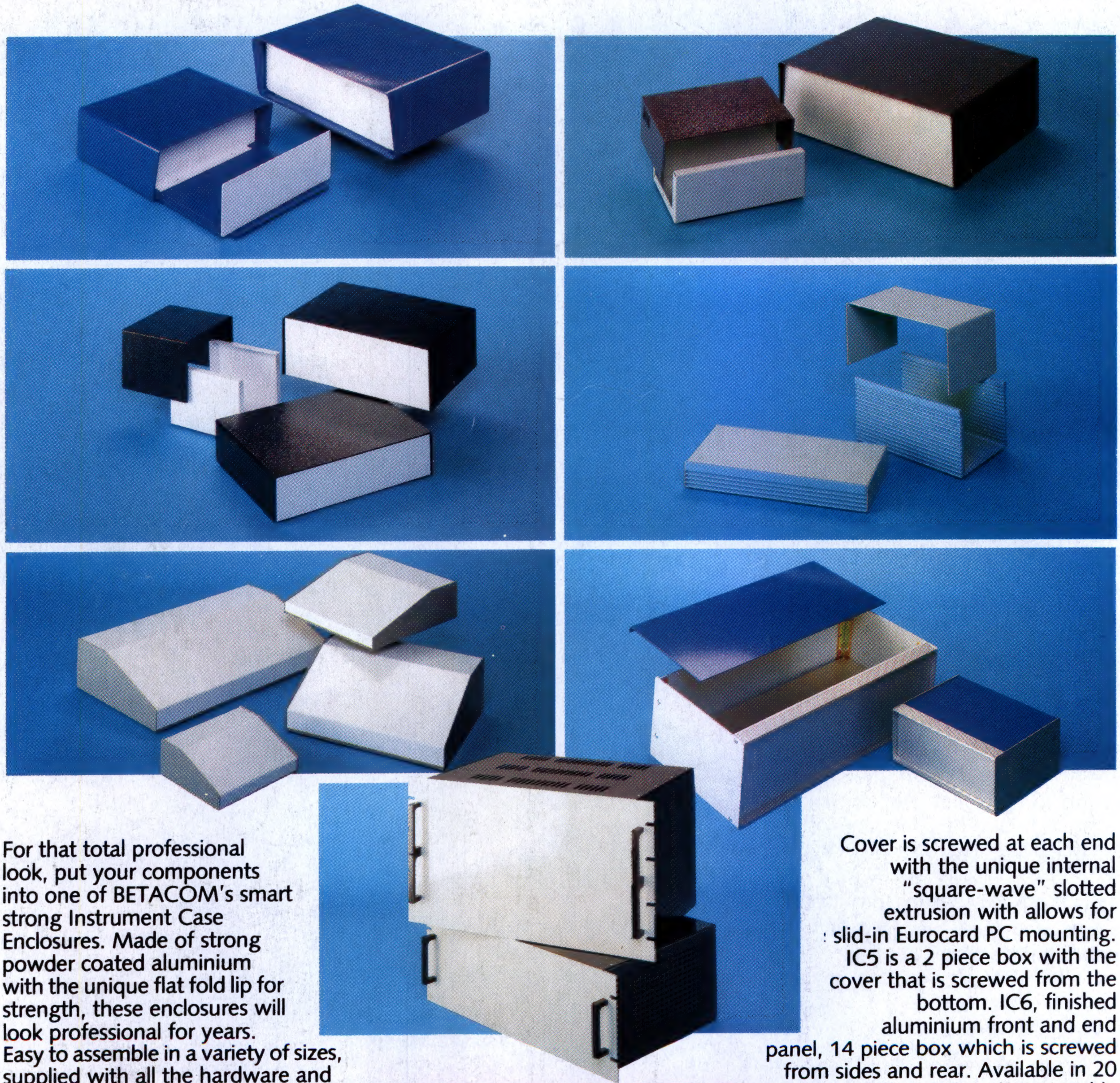

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